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J. 13

January – March 1953

Quarterly Journal

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Robert C. Eller, *Editor-in-Chief*

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Volume XIII, No. 1

January–March 1953

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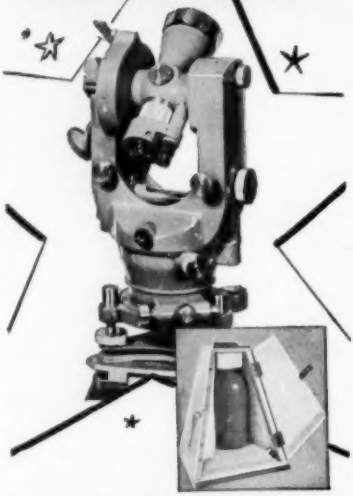

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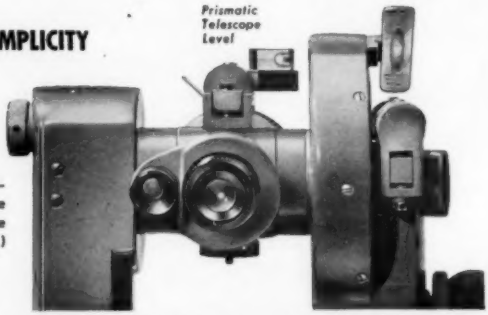

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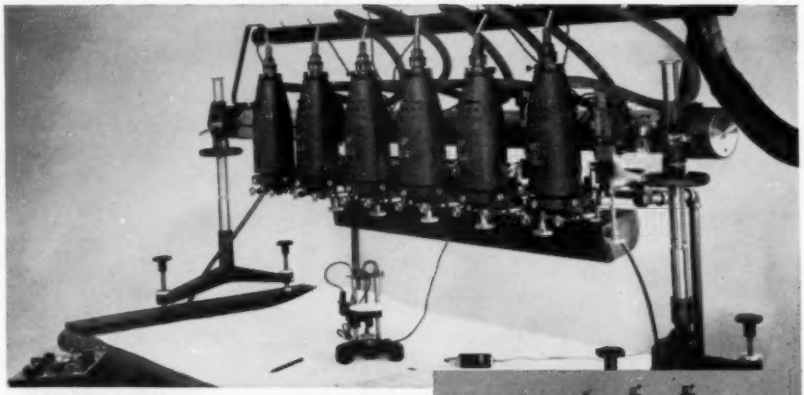

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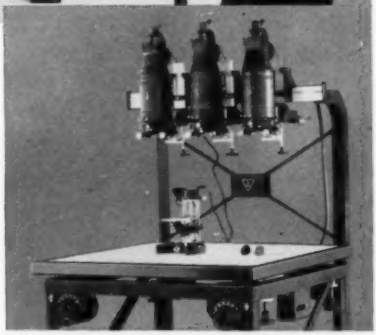

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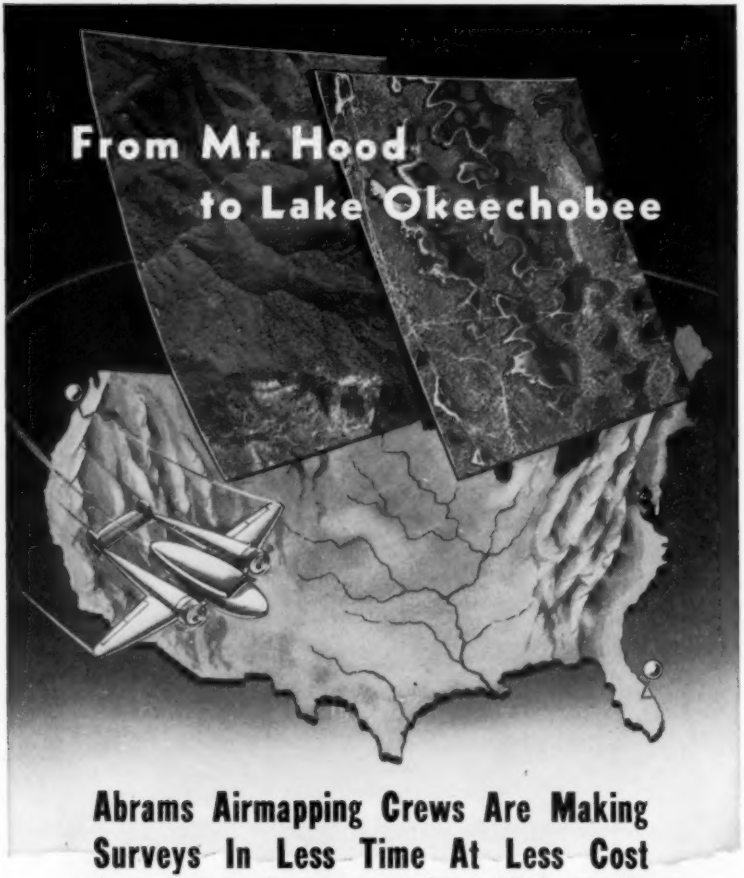

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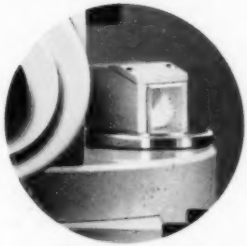

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"...And Remember the Red River Valley"

"Reading in 'The Surveyor's Notebook' collection* about Arthur Kidder and Joe Thoma's cadastral surveys reminds me of the time I worked with them on the Oklahoma-Texas boundary dispute," says Wesson Cook, Planning Engineer, The Maryland-National Capital Park and Planning Commission.

"It was 1926. Under decree from the U. S. Supreme Court, our General Land Office party was assigned the job of re-establishing the boundary line at points where the Red River had changed its course—causing considerable dispute over locations of valuable oil lands.

"Along one 100-mile stretch, the old boundary was often submerged under shallow 'ox-bow lakes' formed by the change in the Red River channel. It was impossible to mark the boundary or set up tripods.

"Here's how we got stations: We drove posts into the muck, then took the head off an old tripod and attached it to an iron bracket which slid down over the posts, and was fastened with clamp screws. With a triangular platform of heavy boards, we were able to walk around the stations without disturbing the transit.

1926 snapshot shows Cook leveling transit set up on boundary post in Red River.

"One day, when we were working under considerable pressure, I lost the crosshairs of my transit. The work *had* to go on and I was afraid I was sunk. The only thing to do was to catch a spider and have it spin new crosshairs.

At Calvert Mansion, Riverdale, Md., HQ of Maryland-National Capital Park and Planning Commission, Wesson Cook sights through a new Gurley.

"We hunted for one; and, after finding a nice specimen, kept the little devil warm under glass until it had spun enough to help me. The biggest part of the job was getting the web in place. After spending the good part of an afternoon at the tedious job, I had crosshairs again. The work went on.

"This, of course, was before the days of glass reticles, and would never happen today with a Gurley Transit. I've used just about every make; and I'd say it's going to be pretty hard to beat a Gurley for accuracy and ease of adjustment."

***Kidder and Thoma's** account of cadastral surveying with a solar transit, Thoma's remedy for "frozen" tripods and all other stories and surveying tips from the first year's *"Surveyor's Notebook"* series have been gathered into permanent booklet form. Write for your free copy of *"The Surveyor's Notebook."* You'll find it very helpful.

When writing for your bound copy of "The Surveyor's Notebook" stories, ask also for Bulletin 50. It gives full details on Gurley instruments.

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Opinions or assertions expressed in articles in this Journal do not necessarily represent the official views of the CONGRESS.

The Editor Says Farewell

The publication of the October-December 1952 issue of SURVEYING AND MAPPING rounded out for me a full decade of service as editor-in-chief of the American Congress on Surveying and Mapping.

Although official business weighed heavily at the beginning of 1952, I nevertheless agreed to remain as editor in order to acquaint the newly appointed assistant editor, Robert C. Eller, with the responsibilities he was to assume, as editor, in 1953. This arrangement proved mutually beneficial. It provided me with much-needed assistance, and at the same time gave the assistant editor an opportunity to learn, through actual participation, the multiplicity of problems associated with the preparation of the Journal for publication.

As I now take leave from actively directing the editorial policies of the Journal, I do so with the satisfying knowledge that I am passing the mantle on to one who has worked closely with me for a full year, and with the confidence that under his editorship the high quality of the Journal, developed through many years of painstaking effort, will be maintained. We should never again have to face a choice between lower editorial standards and uncertain publication dates. Thanks to the recommendations of the Special Committee on Publications Policy, we now have an efficient working arrangement between the Editor's office and the Publications Committee, with an equitable division of the workload. The effectiveness of this arrangement was demonstrated during the past year when our Journal had to be adjusted to the requirements of commercial advertising.

While the pattern for the Journal is set, improvements will and should be made, dictated by the needs of a progressive and forward-looking organization. I am confident that my successor will be alert to these needs. I bespeak for him the same cooperation that has always been extended to me by officers and authors—one of the compensations that makes voluntary service palatable.

A. L. SHALOWITZ

In bringing to a close my long tenure as editor-in-chief, I do so with a feeling of relief, yet mingled with regret. Naturally, a time like this conjures up many memories—some pleasant, some not so pleasant. Magazine publication was new to me when I assumed the job of editor ten years ago. I had to learn the hard way, without direction and without guidance. The emergence of our publication from a small eight-page news bulletin to a full-fledged technical Journal is one of the pleasant memories.

I shall always cherish the associations I have made in the Congress. As I take my place on the editorial sidelines, I shall watch regardfully the continued growth of our Journal. I envision it as a wonderful medium for service.

A. L. SHALOWITZ

Precise Contouring by Random Level Lines

By SERGE A. EMERY

CIVIL ENGINEER, FREEPORT, L. I., N. Y.

WHERE an extensive land improvement project is contemplated, the accurate determination of the topography of the area becomes a matter of necessity. The flatter the land and the more costly the development, the more exacting is the requirement for accurate determination of the elevations.

In rough or hilly country, stadia leveling is a rapid and economical method of determining elevations. Unfortunately, stadia leveling is not accurate enough to give satisfactory results in an almost level area, and recourse is often had to the so-called "cross-section" method of leveling. In this method straight, parallel, equally spaced lines of levels are run with elevations determined at equal distances along the lines, the intervals between elevation determinations being usually equal to the spacing of the lines. In effect, this is equivalent to dividing the area into squares (usually with sides about 100 feet long), and determining the elevation of every corner of every square.

Plotting a cross-section survey on a map is quickly and easily done and presents no difficulties, so long as the level lines are well chosen and accurately located. The field work, however, is not always so simple. The square grid must be accurately laid out and it is necessary to determine the elevations of additional points on the intervening slight rises and in the depressions. This method of leveling encounters the greatest difficulties where the work is done on level but overgrown terrain. To run the net of cross-section lines on such ground, one has to cut lanes for sighting, which slows the work and increases its cost. So it can be said that the cross-section method is not always economical in an irregular, rugged, or overgrown area. Where the ground is extensively covered with thick vegetation, the question arises as to whether it is wise to use this method at all.

In practice, it often happens that it is also necessary to make a cadastral survey of the area in which the elevations are required. In most cases one has to survey the boundaries of the area and locate all the important natural and artificial objects in it. For this purpose triangulation and traverse points are usually established along the boundary and also within the area.

In this article a method of determining spot elevations for the precise contouring of the whole area of a community is described; this method differs considerably from the commonly used cross-section method. This area comprised about 14,000 acres, in the approximate middle of which was a village. Around the village there were farms with various kinds of buildings, orchards, vegetable gardens, small tracts of cultivated forest, and other improvements.

It was necessary, first of all, to survey this area, to measure its outside boundaries and to establish these boundaries with relation to the boundaries of the adjacent villages. Then it was necessary to locate all permanent and important objects lying within the area, such as highways, bodies of water, cultivated forests, orchards, farm buildings, etc. To do this, 45 triangulation points were established throughout the entire area, and these were marked with concrete posts measuring 8 by 8 by 30 inches. This triangulation control was supplemented by traverse, about 1,200 traverse stations being established. Each traverse station was marked with a concrete post measuring 5 by 5 by 20 inches. All these concrete posts were flat on top and protruded 2 inches above the ground. Each triangulation and traverse station was identified by number. The plane coordinates of all these stations were calculated.

To provide for the necessary drainage the officials ordered that elevations be accurately determined throughout the whole area.

Contours with an interval of 10 centimeters (4 inches) were specified. Such accuracy was required because the entire area was very flat and had only a very slight slope; the difference in elevation between the highest and the lowest points was only about 20 feet. The area was about 35 percent overgrown with bushes and trees so that in many places it was possible to sight only short distances along the ground.

To determine the required elevations in this area, the precise elevations of the 45 triangulation points were first determined by reference to two government bench marks. In this way, the 45 triangulation points were established as primary bench marks. Then, by level lines run between each two adjacent triangulation stations, the elevations of all the traverse stations were determined twice, so that they became secondary bench marks. This gave about 1,245 bench marks in the area.

The soil in this area was very soft and in some places was just plain mud, so it was necessary at almost every rod reading to use a metal footplate, called a "frog" (figure 1).

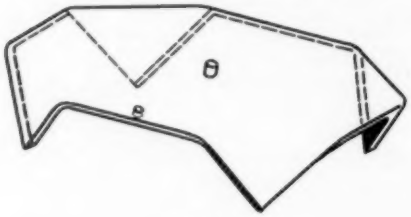


FIGURE 1

This iron footplate was about ¼ inch thick and its top was 8 by 8 inches in size. The rodman first placed the "frog" firmly on the ground, pressed it in with his foot and then held the level rod on the peg in the middle of the "frog." A wire was attached to the footplate so that the rodman could easily lift it from the ground and carry it with him.

After the elevations of the bench marks had been determined, the detailed leveling was carried out. The area was divided into two parts, the northern part containing about 8,000 acres and the southern part about 6,000 acres. Elevations in the northern part were determined first. As there were four field parties, the northern part was divided into four approximately equal parts, one field party working in each. Each field party consisted of four men: the chief-of-party who directed the work and made the field sketches; the levelman; the rodman who carried the level rod and helped measure the distances; and the tapeman. The levels were run with Wild instruments, which were provided with horizontal circles for use in measuring horizontal angles.

The starting point and direction of each "profile line" were selected by the chief-of-party, who had to take into consideration the nature of the ground and the vegetation cover between the starting point and a bench mark or a point of elevation on one of the traverse lines (figure 2). The chief-of-party would indicate the direction of the profile line by pointing to an unusual tree, the corner of a house, or some other distinctive, visible object. If there was no such object, he would mark the direction by means of a rod held as far as possible from the starting point. The starting point was usually on a traverse line and the distance between the starting point and the nearest traverse station was measured. Each level line began at a bench mark (traverse station) and ended at a similar point.

The rodman held the rod on the high and the low points along the profile line, and where it was impossible to detect any elevation differences with the naked eye, rod readings were taken at distances of about 30 meters from one another. The distances between all points whose elevations were determined were always measured. Where it was necessary to determine the elevations of points to the right or to the left of the profile line, the perpendicular distance from the profile line was measured and the elevation of the point determined. These perpendiculars were erected by the chief-of-party, using the double pentagonal prism (*Civil Engineering*, May 1948, page 46). Topographic features, such as depressions or rises, apparent to the naked eye were

marked on the sketch by the chief-of-party and the necessary measurements were made to determine the locations and elevations of these features.

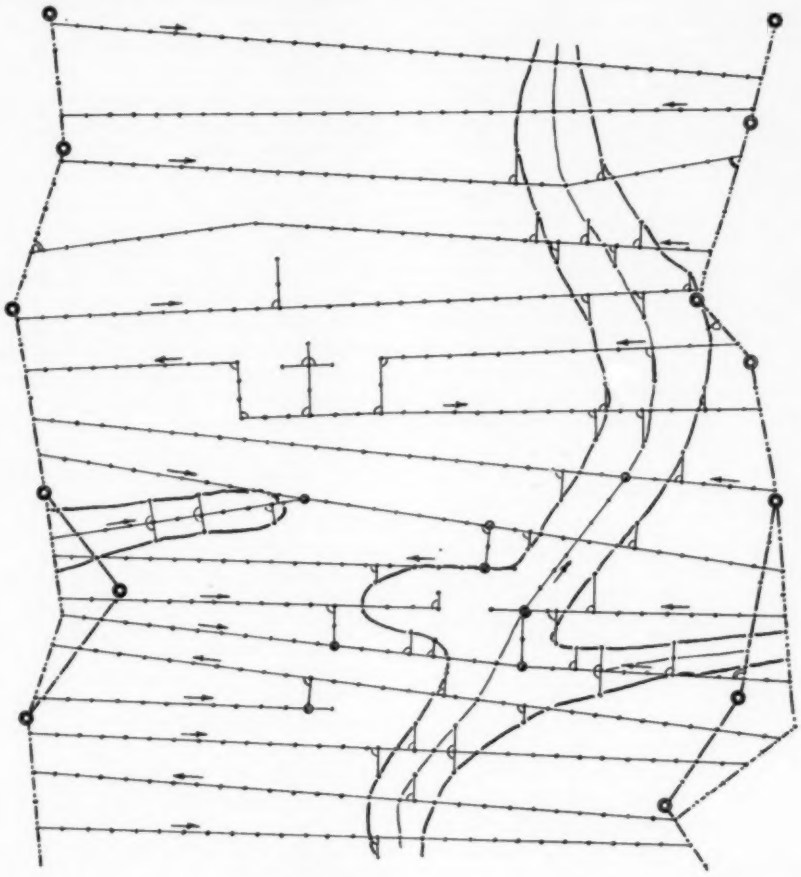


FIGURE 2

Where obstructions made it impossible to continue a straight profile line to the desired final intersection with a traverse line, a slight angle was made in the profile line or sometimes an obstruction was bypassed by means of three perpendiculars (*see* figure 2). Sometimes it was necessary to determine the elevations of points in a direction transverse to that of the profile lines. To do this, a point was selected on one profile line and marked, and when the next profile line was run, an appropriate point was again selected on this line and levels were then run in a straight line between these two selected points. Such points were called "small points." "Small points" were selected not only on the profile lines, but also at the ends of the perpendiculars erected to these lines.

Each point whose elevation was determined was given a number. The point was recorded by the levelman under this number, and the chief-of-party marked it on his sketch. Points were usually numbered consecutively from 1 to 1,000, and then a new series was started at number 1 again.

Distances between profile lines varied between 100 and 350 feet. The lines were 500 to 5,000 feet long. Where it was necessary to change the direction of a profile line, the angle that it formed with the traverse line was measured by the levelman, using the circle provided on the level for the measurement of horizontal angles. As a rule, it was satisfactory to measure this angle at the end of the profile line. Approximately 85 percent of all the profile lines were straight from the starting point to the end on another traverse line.

Only 20 to 25 profile lines were of such a nature as to require several angles in order to by-pass obstacles. In these cases, each angle had to be measured, and the leveling instrument had to be set up on the line at the intersections, whereas on all other profile lines the elevations could be measured from the instrument set up at any convenient place.

After the elevations in the larger northern part had been determined, the southern part was also divided into four parts to accommodate the same four field parties.

To complete the work throughout the total area, each of the four field parties worked 35 days. The elevations of about 37,000 points were determined, or an average of 2.7 points per acre. The results were computed and the profile lines and points were plotted on the maps. All triangulation and traverse stations (bench marks) had previously been plotted on the same maps. Then the contours were drawn, and, based on these contours, the drainage project was designed. As a result of such well-planned and well-executed field work, much unnecessary excavation for drainage was eliminated. The complete drainage of the land and the reclamation of about 25 percent of the area for agricultural use attested to the excellence of the method described above. The length of the drainage system totaled about 140 miles.

This method of determining elevations can also be applied to smaller areas as, for example, in property surveying for subdivisions. Usually the area of the land to be subdivided must first be surveyed, and the coordinates of the traverse stations must be computed. Where the land is flat and covered with trees and brush, this described method will prove faster and less expensive than the usual cross-section method, and numerous horizontal and vertical checks are provided.

In summary, the advantages of the described method can be stated as follows:

1. Less time is usually required than with the cross-section method.
2. Time and effort are saved by avoiding obstacles, such as bushes and trees.
3. The directions of the profile lines can be adjusted to the configuration of the terrain.
4. Elevations can be checked because each line begins and ends at a bench mark.
5. The horizontal measurements of the profile lines can be checked where necessary, because each length can be checked against the coordinates of the traverse stations.
6. The total number of detail points is much less because the average spacing between profile lines can be greater than in the cross-section method.

Stadia Characteristics of the Internal Focusing Telescope

By WILLIAM MUSSETTER

THE internal-focusing telescope was introduced in Europe about 50 years ago and soon became the standard design applied to surveying instruments. It was not until many years later that its manufacture in America was begun, but here, too, the design soon found favor to the extent that practically all transit and level telescopes are now of the internal-focusing type.

The advantages leading to the general adoption of the new design are well known. Among them is the possibility of reducing the stadia constant[1] to a negligible quantity, and the unqualified claim has often been made that this constant is eliminated. This is never strictly true and the facts may vary greatly in different designs. Furthermore, the stadia ratio is not a constant, as in the external-focusing type, but changes for different distances of the rod. In fact, it is the presence of two variables—the change in the location of the apex of the stadia triangle and the variation of the stadia ratio, which by proper design may be made to cancel substantially—that accounts for the near elimination of the stadia constant. The following brief analysis is offered to acquaint interested surveyors with the stadia characteristics of the internal-focusing telescope.

In any telescope the object observed and its image must lie at conjugate distances from the objective glass.[2] In the surveyor's telescope, the image must fall in the plane of the cross-hairs, or reticle, and the latter must be at a distance from the objective conjugate to that of the object. The equation relating to conjugate distances is

$$\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2} \qquad (1)$$

in which f is the principal focal length of the objective, f_1 is the distance from the lens to the object, and f_2 the distance from the lens to the image. This equation may be written,

$$f_2 = \frac{ff_1}{f_1 - f} . \qquad (2)$$

The internal-focusing telescope maintains the distance f_2 constant, hence any change in f_1, that is, in the rod distance, is accompanied by a change in the value of f. The ratio of f to the distance between the stadia lines is the stadia ratio. The ratio is, therefore, variable with the rod distance.

Any telescope that measures a range by means of similar triangles, one of which depends on an optical dimension, refers the distance to a point in the optical system known as the anallatic point.[3] In the external-focusing type, the anallatic point coincides with the anterior focal point of the objective which lies at the fixed distance f in front of the lens. Location of this point in an internal-focusing system is not so simple, there being no fixed anallatic point, but, instead, a different one for each value of f_1. The actual location of this series of points depends on the optical dimensions.

The internal-focusing telescope is shown diagrammatically in figure 1. The objective system comprises the positive lens O and a negative lens N lying between O and

[1] The term "stadia constant" is retained because it is in such general use by surveyors. The quantity is not a constant in the internal-focusing telescope.

[2] For simplicity, the lenses are treated as without thickness. Neglect of the distance between their principal planes has no effect on the theory or mathematics of the analysis. A measurement from a lens is, of course, taken from the appropriate principal point.

[3] A telescope in which the anallatic point lies at, or very close to, the horizontal axis is called "anallatic" (also spelled *anallactic*—German, *anallaktishe;* French, *anallatique*). Hence, the internal-focusing design is often referred to as the anallatic telescope.

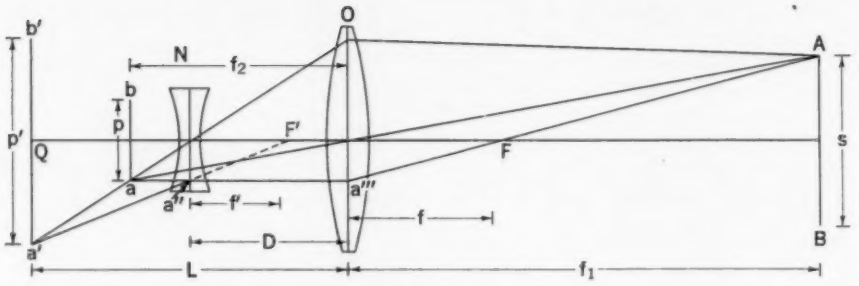


FIGURE 1

the plane of the cross-hairs at Q. The dimension L represents the length of the telescope and is fixed. Focusing is attained by sliding the negative lens in a guide, altering the separation D. The equivalent focal length f_o of a pair of lenses, as these, is given by the formula,

$$f_o = \frac{ff'}{f + f' - D} \qquad (3)$$

in which f is the focal length of the positive lens, and f' that of negative lens. Therefore, the focal length of the combination varies with D.

Referring to equation (2), the equivalent focal length f_o is now used in place of f as for the case of a single lens. It is seen that as f_1, the rod distance, is diminished, f_o must decrease in order to keep f_2 constant. This is done by increasing D in accordance with equation (3). Hence, the stadia ratio, $\frac{f_o}{i}$, i being the interval between the stadia lines, decreases with diminished rod distances. Therefore, as the distances become shorter, the ranges obtained by treating the stadia ratio as a constant become too great, and a negative correction should be applied. On the other hand, the quasi-anallatic point, from which the measured distance applies, retreats toward the rear of the telescope and causes an error of the opposite sign. We must now find the effects of these two errors on the indicated distance.

The problem may best be visualized by first considering that the negative lens is not present. A ray from A through F then follows the path AFa''' a'' a, and the image is formed at the distance f_2 behind the objective lens. The stadia distance is then given by the common formula,

$$f_1 = \frac{fs}{p} + f. \qquad (4)$$

When the negative lens is inserted, the ray is refracted by it toward a', and an image of the rod is formed at $a'Qb'$, larger than the image ab. It is now necessary to substitute for p in equation (4) its value in terms of the dimension of the new image p', in order to find f_1.

The ray incident on the negative lens being parallel with its axis, the deviation is such that $a'a''$ extended passes through the focal point of the lens at F'. Then,

$$\frac{p}{p'} = \frac{f'}{F'Q} = \frac{f'}{f' + L - D},$$

and

$$p = \frac{p'f'}{f' + L - D}.$$

Substituting this value for p in equation (4) we have,

$$f_1 = \frac{f(f' + L - D)}{f'p'} s + f. \qquad (5)$$

For any given telescope, f, f', and L are constants. There are several algebraic solutions to determine the relation of f_1 to the rod intercept s. The curve of this relation is shown to be a nondegenerate hyperbola and therefore no linear function can be substituted for it without some degree of approximation. The mathematics of a direct approach to the problem are somewhat in-

volved. However, there is a relatively simple method for finding the error of the linear approximation which was presented by Major E. O. Henrici[4] in "Transactions of the London Optical Society," 22, 1921–2. This method derives the error as a function of the movement of the negative lens.

Returning to equation (5), let the separation at infinity focus be denoted by D_∞, and the movement of the lens by d. Then D for any focus equals $D_\infty + d$. Thence,

$$f_1 = \frac{f(f' + L - D_\infty - d)s}{f'p'} + f.$$

The quantity $\frac{f(f' + L - D_\infty)}{f'p'}$ is a constant; let it be denoted by k, then,

$$f_1 = ks - \frac{fsd}{f'p'} + f. \tag{6}$$

The stadia lines are almost always spaced so that $k = 100$.

If, as is usual, the distance from the objective to the rod is taken as ks, the two remaining terms are the error arising from this approximation. This error is designated by E.

From figure 1,

$$\left.\begin{aligned} &\frac{L-D}{f_2-D} = \frac{p'}{p} = \frac{f'+L-D}{f'}, \\ &\text{therefore,} \\ &f_2 = \frac{f'L + DL - D^2}{f' + L - D}. \end{aligned}\right\} \tag{7}$$

Also, from equation (1),

$$f_1 = \frac{ff_2}{f_2 - f}. \tag{8}$$

It is convenient first to consider the case of infinity focus, and to express D_∞ as a fraction of L, thus, $D_\infty = nL$, n being less than 1. Then D, the separation for any value of f_1, is equal to $nL + d$. For infinity focus, $f_2 = f$, and $d = 0$. Then, from equations (7) and (8),

$$f_{2\infty} = f = \frac{L^2 n(1-n) + f'L}{f' + L(1-n)},$$

thence,

$$f' = \frac{L(1-n)(f - nL)}{L - f} \tag{9}$$

and

$$f' + L - D_\infty = \frac{D^2(1-n)^2}{L-f}. \tag{10}$$

Substituting (8) and (10), and also $(D_\infty + d)$ for D, in equation (7), we have for any focus,

$$f_2 = \frac{\left(\begin{array}{c} -d^2(L-f) \\ +Ld(1-2n)(L-f) \\ +L^2(1-n)^2 f \end{array}\right)}{L^2(1-n)^2 - d(L-f)}, \tag{11}$$

and from (5),

$$f_1 = \frac{\left(\begin{array}{c} f[-d^2(L-f) \\ +Ld(1-2n)(L-f) \\ +L^2(1-n)^2 f] \end{array}\right)}{\left(\begin{array}{c} -d^2(L-f) \\ +d[L^2(1-2n) + f(2nL-f)] \end{array}\right)}. \tag{12}$$

Referring again to equation (6) and to the value assigned to k,

$$\begin{aligned} f_1 - f &= ks\left(1 - \frac{\frac{fd}{f'p'}}{\frac{k}{}}\right) \\ &= ks\left(1 - \frac{d}{f' + L - D_\infty}\right). \end{aligned}$$

Substituting the value of $(f' + L - D_\infty)$ as given in equation (10) in the above,

$$ks = \frac{(f_1 - f)L^2(1-n)^2}{D^2(1-n)^2 - d(L-f)}. \tag{13}$$

Substituting the value of f_1 from (12),

$$ks = \frac{f^2L^2(1-n)^2}{\left(\begin{array}{c} -d^2(L-f) \\ +d[L^2(1-2n) + f(2nL-f)] \end{array}\right)}. \tag{14}$$

[4] The full mathematical development which follows in this paper is the same as that given by Major Henrici in this reference. Because of the lack of complete information on this subject in American textbooks and journals, it is very desirable that this detailed discussion be made more readily available to instrumentmakers and surveyors in the United States.—Ed.

Then,

$$E = f_1 - ks = \frac{f[L(1-2n)-d]}{L(1-2n)+f-d}. \quad (15)$$

An inspection of equation (15) at once shows some pertinent facts concerning this type of telescope. If n is made to equal $\frac{1}{2}$ at infinity focus, E becomes zero; that is, the anallatic point lies at the objective lens. If n exceeds $\frac{1}{2}$, E becomes negative, and the anallatic point falls to the rear of the objective. When n is less than $\frac{1}{2}$, E is positive and the anallatic point lies forward of the lens.

Equation (9) shows that, as n increases, f' decreases. Hence, there is a practical limit for the value of n, because f' cannot be reduced to less than about $0.6L$ for use with suitable objective apertures without unduly reducing the focal-length-aperture ratio of the negative lens. Besides, there are mechanical limitations on the approach of the negative lens toward the reticle which control the value of n. The same equation shows that as f increases, f' also increases.

Equation (3), giving the equivalent focal length, shows that f_o increases with an increase in D, that is, in n, and in the numerical value of f'. An increase in f_o within limits is desirable, because the advantages of a longer focal length, such as longer focal length of eyepiece, greater eye relief, etc., are obtained in a telescope of given length. Conversely, the length of the telescope for given qualities can be reduced. The focal length usually exceeds the telescope length by 25 percent or more.

Again, from (15), we see that increasing n for a given value of f causes the algebraic value of E to decrease at a more rapid rate with a decrease in rod distance.

The designer is, therefore, confronted with the problem of effecting the best compromise of these elements. The quantity E is measured from the objective glass. If it can be made negative and numerically equal to the distance at which the instrument's center lies behind the objective, then the vertex of the stadia triangle is at the center, and the instrument is truly anallatic. However, this can be true only for one distance of the rod, and no instrument of this type can be made theoretically anallatic at all distances.

A large ratio of focal length to aperture (f-number) is always desirable; hence, the objective lens is selected with a focal length of $0.8L$ to $0.9L$. The desired value of E is influenced by the location of the center in respect to the objective, and is dependent on n, which is accordingly selected, limiting values being kept in mind. The objective focal length and n now fix f', and all together fix the value of f_o.

In practice, for transit and theodolite telescopes intended for tacheometry, f is near $0.9L$, n about 0.65, and f' is $0.88L$. For such a telescope, E is $-0.45L$ at infinity focus, or close to half the length of the telescope. By choosing the distance between the objective and the instrument center, the stadia constant may be made zero for any given rod distance. This may be chosen at infinity, or at some average distance, say 300 feet.

The catalog of an American instrument maker shows a diagram which, if drawn to scale, represents an erecting telescope of approximately the following dimensions: $L = 7$ inches, $f = 6.3$ inches, $n = 0.55$, and the distance between the objective and the center, 4.9 inches. The value of E for a rod distance of 100 feet is approximately -0.9 inch, and the stadia constant is about 4 inches. At 10 feet, E is about -3.8 inches and the constant is $+1.1$ inches. The catalog states that the constant is negligible, although it seems to be about 1 part in 300 at 100 feet. Erecting telescopes present a special problem in that the length of the eyepiece causes the center to fall well toward the rear of the objective system.

A European design for which exact dimensions are available has $L = 154$ mm., $f = 136$ mm., and $n = 0.66$. E_∞ for this instrument is -76 mm., showing that the anallatic point is very close to the instrument center.

Table 1 gives the values of E measured from the objective lens, in terms of the telescope length L, for various rod distances, for a typical telescope whose assumed di-

mensions are: $f = 0.9L$, $n = 0.65$, and $f_o = 1.26L$.

TABLE 1

Rod Distance	d	E
∞	.0000	$-0.450\,L$
664 L	.0025 L	.456
333	.005	.461
168	.01	.473
85	.02	.497
57.5	.03	.521
43.8	.04	.546
35.5	.05	.573
30.0	.06	.600
26.1	.07	.628
23.4	.08	.658
20.9	.09	.688
19.1	.10	.720
13.8	.15	.900
11.3	.20	−1.125
09.9	.25	−1.414

If the instrument center is $0.5L$ behind the objective of this telescope, the error from ignoring the stadia constant varies from $-0.05L$ at infinity to about $+0.9L$ at a rod distance of $10L$.

Figure 2 shows an error curve for the same telescope with the further assumption that $L = 0.8$ foot. The radiating lines *aa* define an area within which the error in the indicated rod distance does not exceed 1 part in 1,000, assuming the instrument center to be 0.4 foot back of the objective. All distances greater than 36 feet fall within this limit. The lines *bb* bound a similar zone, the center being 0.45 foot from the objective. The curve lies within this zone for all distances beyond 25 feet, but the error for the greater distances is larger than in the former case.

The linear error varies with L, and is less for shorter telescopes. Figure 2 shows that very short sights are subject to a large error unless a correction is applied.

The significance of the approximations noted depends on our attitude toward stadia measurements. If we admit that the rod readings are the source of overshadowing errors, and consider the error as a linear one rather than a proportionate one, we can accept the statement that the error caused by ignoring the instrument constant is negligible in the case of a well-designed instrument. However, it would probably be a better policy for manufacturers to furnish the error curves for their instruments so that the corrections could be considered when desired. Perhaps some standard should be set up by the surveying profession, say an error of 1 part in 1,000, within which an instrument could be accepted as meeting the definition of the word "anallatic."

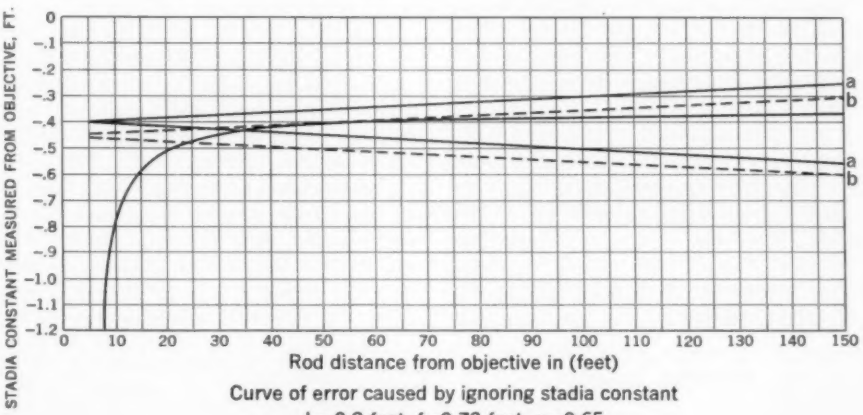


FIGURE 2

Processing and Charting the Hydrographic Survey

By REAR ADMIRAL ROBERT W. KNOX
ASSISTANT DIRECTOR, U. S. COAST AND GEODETIC SURVEY

SINCE its inception in 1807, the principal function of the Coast and Geodetic Survey has been that of providing charts for the mariner so that he can safely and expeditiously navigate the coastal waters and the inland tidal waters of the United States, its territories, and possessions.

The areas covered by these surveys adjoin approximately 100,000 miles of coasts and tidal shoreline. More than two million square miles of river, harbor, and offshore waters must be adequately covered by surveys in the interest of water-borne commerce and navigation. Approximately one-third of this area has been covered by adequate modern surveys.

During the past year about 100 individual hydrographic surveys, some covering areas as large as 12,000 square miles, were completed by field officers manning the 17 survey ships in the service of the Coast and Geodetic Survey. Most of the surveys in recent years cover previously unsurveyed areas along the Aleutian Islands, in the Bering Sea, and along the Arctic coast.

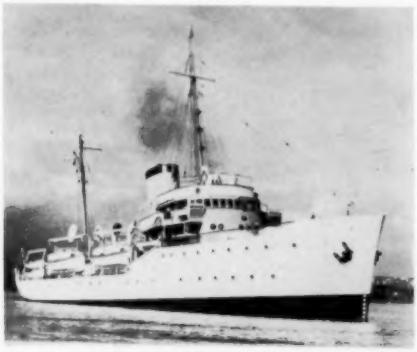


FIGURE 1.—The *Explorer*, a modern U. S. Coast and Geodetic Survey ship.

Presented at Twelfth Annual Meeting, American Congress on Surveying and Mapping, Washington, D. C., June 11–13, 1952.

Other surveys that are in progress along both coasts of the United States and in Southeast Alaska are superseding old original surveys, which do not provide the adequate hydrographic data necessary for modern navigation. Modern vessels, drawing as much as 40 feet, have made obsolete many original surveys of a period when 20 feet of water was safe for any vessel afloat. New electronic methods of navigation demand detailed surveys at least to the seaward edge of the continental slope.

Although a hydrographic survey is made primarily as source data for nautical charts, it serves also as an original public document. Photographic copies are frequently furnished to other government agencies, private industry, and the general public. The surveys are used for compiling bathymetric maps and for oceanographic and sedimentation studies; industry is using the surveys in studies of natural resources, particularly oil; and certified copies are used in legal proceedings.

In speaking of the hydrographic survey, I am using the term in its broadest sense—including hydrography on one side of the shoreline and topography on the other. It has always been our practice, however, to survey the two separately, and combine them later in the office—partly on the smooth hydrographic sheet and more fully on the nautical chart.

Hydrographic surveys are made principally to locate dangers and obtain soundings that will be adequate for the delineation of the submerged topography. A complete survey, however, includes all foreshore detail, navigational aids, rocks, islets, structures, and all landmark features of value to the mariner; also included is a band of topography of varying width for possible use in offshore position fixing. Both the low- and high-water lines are frequently of great importance in legal proceedings in-

volving political and civil boundaries. Complete and accurate knowledge of the foreshore is also necessary for successful amphibious operations.

In offshore waters extending out over the continental slope into sea and ocean basins, new surveys are continually revealing significant submarine features, such as submerged reefs, shoals, canyons, and seamounts, which serve as submarine landmarks to the modern mariner. The surveys of these features, together with a complete delineation of the submarine physiography, also provide scientific information of value to oceanographers, geologists, marine biologists, and other students of the earth sciences.

Before this hydrographic information is issued in the form of a nautical chart it is

FIGURE 2.—A smooth plot of part of Catalina Harbor, California, after verification by the Washington office.

subjected to a processing operation involving verification of the smooth plot, evaluation of the hydrographic coverage, and compilation of the chart manuscript.

VERIFICATION OF THE SMOOTH PLOT

In the reduction of observational data to absolute values, the final data must be completely verified. Considerable checking is done in the field, but the hydrographic data recorded on the smooth sheet is not verified until it is received in the Washington office.

Newly discovered features of importance to the mariner, such as critical depths, are applied to the charts immediately without waiting for the complete verification of the smooth sheet. The stock of published charts is often hand-corrected to show these features.

The verification of a survey is in effect a complete check of the field observations and of the accuracy of the smooth plot of the hydrographic data.

The field engineer plots his survey on a field sheet called the boat sheet. Plotted on this sheet are the positions of the survey ship, the soundings, and the various hydrographic and topographic features observed during the progress of the survey. A log of the observed data is maintained at the same time. Recorded in this log, or sounding volume, are observed soundings scaled from graphic fathometer records, together with tidal reductions and other numerical adjustments necessary to reduce the soundings to true depth at the plane of reference. Some surveys require as many as 60 of these volumes, and the graphic fathometer record obtained during one day's sounding in inshore waters is approximately 75 feet long. This record, or fathogram, is folded like an accordian so that it can be easily filed and readily examined to check the soundings.

Inasmuch as the boat sheet is plotted under field conditions and is frequently exposed to adverse weather conditions, the survey is subsequently plotted on a smooth sheet. This sheet is plotted either on board ship or at a field office ashore. The soundings and other hydrographic detail are plotted in pencil, subject to verification before inking in the Washington office.

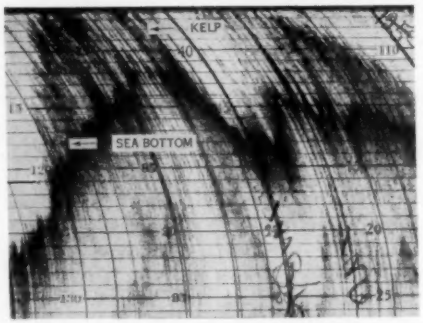
Although a standard procedure is followed in verification, each survey or group of adjoining surveys has aspects that are unique to the individual survey or area covered. Interpreting the fathogram record in areas where the bottom is covered with a mantle of marine growth is probably the greatest problem with which we are confronted in determining true depths. Dense kelp reflects a sound echo which occasionally blots out the graphic record of the bottom profile. Then, too, recordings of echoes from fish and other transient submerged objects must be properly interpreted. Also, the irregular graphic profile caused by a choppy sea is not too unlike the profile of sand waves on the bottom.

Other problems occur in addition to interpreting fathograms, for in every human, mechanical, or electronic operation, there is always the possibility of error. We approach perfection but only occasionally attain it in a single operation. Verification is, therefore, that safeguard necessary to assure the accuracy of the hydrographic information placed on the nautical chart.

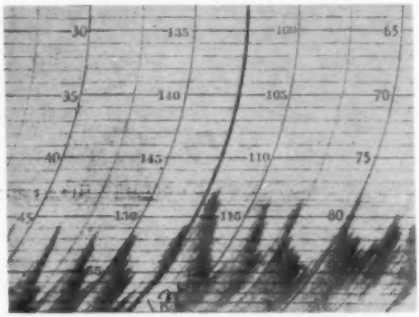
As the verification of a survey progresses, each sounding or other hydrographic feature is inked for permanent record. This is a simple operation in open areas, but considerable care and judgment must be used in congested areas where numerous overlapping sounding lines were run to develop channels, shoals, reefs, and irregular features. Not all pencilled soundings are inked in such areas; the aim is to present a simple and clear delineation of the submarine relief, making certain that channel limits, controlling depths, and the least depths on reefs, are clearly represented on the survey and will be readable on a photographic copy.

In expressing submarine relief by means of depth contours, an attempt is made to represent true conditions correctly rather than to draw the depth contours mechanically outside each controlling sounding. With certain limitations cartographic license

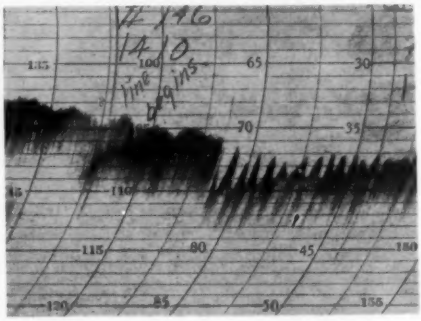
is permitted, and even encouraged, in order that smooth contours may be drawn in smooth-bottom areas, and contours in irregular-bottom areas may be simplified.



REFLECTION OF SOUND BY KELP GROWING ON HIGHER PORTIONS OF SEA BOTTOM



SAND WAVES ON THE SEA BOTTOM



CHOP OF THE SEA ON DIFFERENT COURSES

FIGURE 3.—Fathograms illustrating unusual conditions which create problems in interpreting the record.

As previously mentioned, the hydrographic survey is usually not complete until data has been applied from the contemporary topographic survey. Most such surveys are now obtained by photogrammetric methods. In harbor areas and along rocky coasts aerial photographs furnish an abundance of hydrographic detail. Inconsistencies between the hydrographic and the topographic survey occasionally occur because of inadequate inspection or interpretation of isolated offshore features appearing on the photographs. If the photogrammetric survey has been compiled and field-inspected in advance of, or during hydrographic operations, any conflicts between the two surveys are resolved in the field. Otherwise, conflicting information is evaluated and resolved in the office. Adequate field inspection of the photographs and proper consideration of tide level and tidal range are necessary in order to satisfy navigational requirements. The mariner is aided in his navigation by a knowledge of the vertical relief of offshore and alongshore reefs and rocks.

The complete survey of a hydrographic area is generally considered to be the function of the hydrographic engineer, but in recent years photogrammetric surveys of the coasts have appropriately become a valuable adjunct to the hydrographic survey. The detail applied from these topographic surveys must, then, also be verified.

REVIEW

After the survey has been verified it is turned over to the Review Unit which evaluates the hydrographic coverage as to completeness and reliability. Inasmuch as the review involves hydrographic data appearing on the older surveys and in reports received from various sources, part of the review is made before field work is begun on the new survey. The purpose of the preliminary review is to furnish the field engineer with data which he must verify or disprove and with any information which will assist him in making the survey—information obtained from the old survey records, letters from shipmasters reporting

shoals, and office files not available on board the survey ship. This information allows the hydrographer, before and during the field work, to evaluate the original reports, together with bearings and distances invariably given.

The preliminary review is also utilized later, after the field work has been done and after the survey has been verified. In the final review, all previous hydrographic surveys in the area are compared in detail with the new survey. This comparison may involve as many as 25 prior surveys in areas of unstable bottom. Included in this group may be surveys made over 100 years ago.

Inasmuch as some hydrographic data are applied directly to the nautical chart from information received from other agencies and miscellaneous sources, the most recent largest-scale chart has to be compared with the new survey.

The object of these comparisons is to detect conflicting data and resolve inconsistencies, to evaluate the new survey, and to record historical information abstracted from the review work. Supplemental data are added to the new survey or listed for addition to the chart when necessary. If the hydrographic coverage is not considered complete or adequate, instructions are issued for the required additional field work.

This review work is essentially the third link in the chain of four procedures creating the nautical chart. It connects the present with the past and evaluates the accumulative basic data used in construction of the nautical chart.

In reviewing old hydrographic sheets in the light of data obtained by modern surveying methods, one realizes the prevalence of contradictory conditions in the old surveys. The appearance of the old sheets and records is that of refinement, indicating studious effort and, oftentimes, an eye for beauty. The development of known and critical shoals and reefs was complete and conclusive, and it is unusual when a modern survey can either change their positions or decrease the depths of water over them. However, many *indicated* shoals were not developed and often the soundings obtained were relatively few and spaced far apart—entirely inadequate for delineation of the surveyed area.

In areas of very irregular bottom, as along the New England and Pacific coasts, the discovery by the old-time hydrographers of so many detached reefs by means of such widely spaced sounding lines was truly remarkable, and is an ever present source of wonder to the present-day hydrographer. The reason, of course, lay in training and acute observation.

There were other qualities, however, which are still manifested in the records of the early surveys. The old-time marine surveyor was truly an explorer. He sailed the coasts and followed tidal waters into the harbors and ports which played such a vital part in the early development of commerce and the growth of our country. He wondered at the scenic beauty of the headlands and capes, and he recorded this feature for use in engraved portrayals on the early charts. He was an artist as well as a scientist, and either developed his artistic qualities or inspired his able assistants to create in graphic relief a likeness of the majestic landscape bordering the sea. Many early engravings of our charts include panoramic views originating with sketches made by the early hydrographer. His reports to the Washington office, while retaining the engineer's love for conciseness, were written, more often than not, with a style and feeling not found in the official "federalese" of our day.

In addition to the useful sketches found hidden in the back pages of early field records, other sketches and even verses attest to the spirit of adventure prevalent in the early life of our country. Tragedy is also in evidence, not only in the records of innumerable shipwrecks and loss of lives on the uncharted reefs, but also in the sketches of battle scenes during the Civil War, when many of our officers were attached to topographic companies of the Union Army.

These artistic qualities in evidence on the old survey sheets and charts are commendable. Even the fineline drafting of the soundings and other hydrographic detail

has a striking appearance. But the value of a survey or chart to the mariner is based on a more important quality—that of enabling him to guide his ship safely through dangerous waters.

Although the hydrographic coverage on the old surveys did not generally measure up to the standards required by modern navigation, we cannot lose sight of the fact that these men were thorough in their investigations of individual features. Although they may not have found all the dangerous reefs, these early surveyors obtained many least depths which have been verified by modern surveys and still appear on the charts. In fact, it occasionally happens during the review, that soundings from the old surveys are carried forward onto the new survey—on reefs or stable shoals where painstaking work on the old surveys has not been superseded. Before a decision is made to retain the old data, however, it is verified by reference to the old sounding volumes.

These old sounding volumes are frequently found to be very valuable in resolving discrepancies between the old and new surveys. The review may reveal that an incorrect shore signal or sextant angle was recorded, or that the leadsman misread the markings on the leadline, or that the plotting was in error. The thorough procedure used in processing surveys today was not in effect a hundred years ago, and we have to accept the fact that too many of the charts we are issuing today still have as their basis the inadequate data of the older surveys. Recent estimates reveal that there are approximately 800,000 square miles of navigable waters for which charts are still based on old inadequate surveys.

Some of these surveys are actually obsolete because of changes occurring in areas of unstable bottom. Where these areas embrace inlets or harbor approaches, however, surveys are made at frequent intervals in order that commerce in our waterways may be safeguarded. When comparing

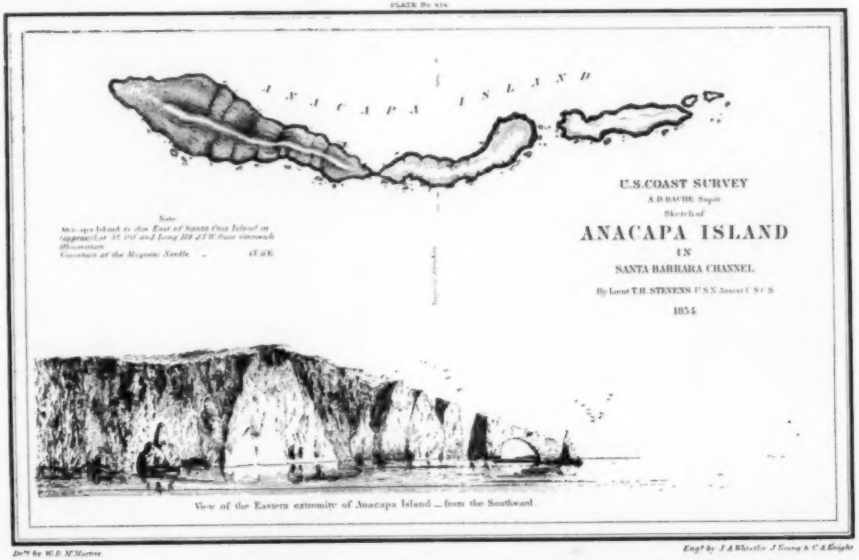


FIGURE 4.—An early chart of Anacapa Island, California, showing one of the finest examples of adornment of charts with views of harbor entrances and headlands. This chart was engraved by James McNeill Whistler while he was employed by the U. S. Coast and Geodetic Survey.

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surveys in these unstable areas, a study of the changing conditions is made so that this historical information can be recorded for planning future surveys and for basic research.

The completion of the review is the final step in the processing of the hydrographic data, except for administrative approval of the new survey.

The survey is then available for use in chart compilation and in various studies made by government agencies and others

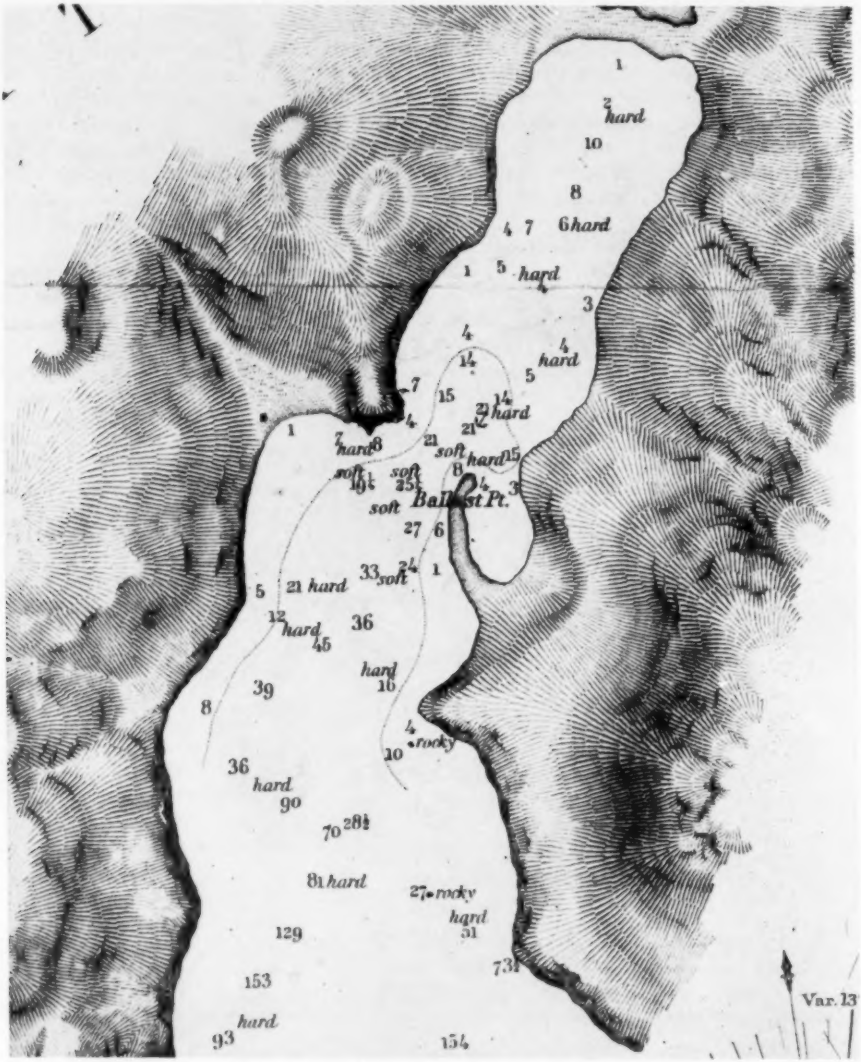

FIGURE 5.—Chart of Catalina Harbor published in 1852. For comparison with a modern chart, see figure 6.

interested in the submarine areas. The survey is an official document and is placed in the permanent files of the Bureau's archives where more than 15,000 hydrographic and topographic surveys are filed at present.

COMPILATION

Assuming that the survey covers a previously unsurveyed coastal area, the next step is the compilation of a new nautical chart.

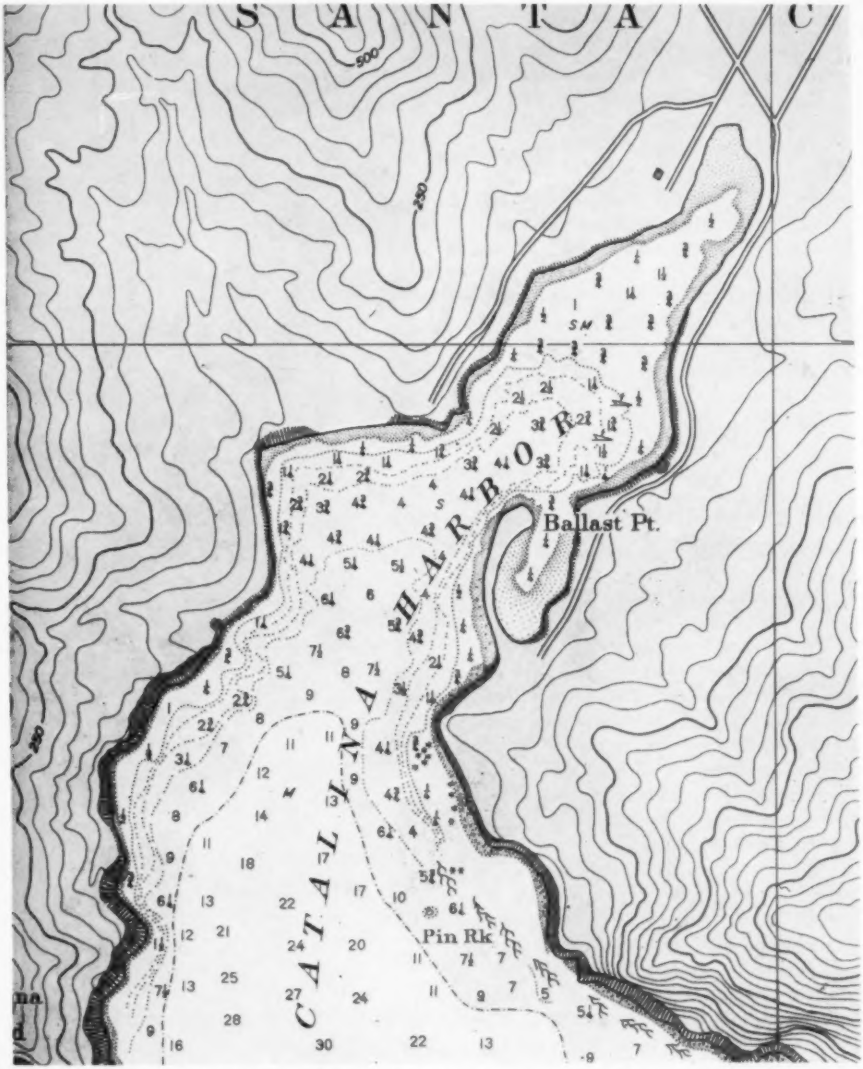

FIGURE 6.—Chart of Catalina Harbor, 1935. This chart was compiled in part from the smooth plot shown in figure 2.

In constructing the chart manuscript, the chief requirements are accuracy as to position, clearness as to readability, and consistency as to uniformity of charting detail. The manuscript is not ordinarily smooth-drafted; this is done in the reproduction process involving engraving on glass negatives; but an occasional manuscript is smooth-drafted during compilation for a provisional chart which is urgently needed.

The compilation of a nautical chart represents cartographic effort of the highest order, as the finished chart is the integration of numerous items of source material into a balanced and harmonious composition. The compiler must combine the faculties of scientific accuracy required of an engineer with the taste and perception required of an artist. Because of the limited means he has with which to express himself, the compiler must study the selection and arrangement of the material presented so as to achieve maximum usefulness with a minimum amount of figures, symbols, and lettering. The keynote of good charting is accuracy with simplicity.

As a general rule, fixed aids-to-navigation and landmarks are first plotted on the manuscript so that the plotting of these vital details can be readily verified in comparison with survey material subsequently applied.

The amount of topography applied to the manuscript depends on the needs of the navigator and on the chart scale. All important topographic features visible from the waterway must be shown so that the navigator may have all available information possible for determining his position. The vertical relief is represented by contour or form lines, supplemented in areas of bold or rugged relief by gradient tints in various shades of brown.

The first hydrographic features applied to the chart manuscript are the channel lines, ranges, and floating aids-to-navigation, followed by rocks and other dangers to navigation and selected critical soundings. Selected depth curves and representative soundings are then added in such a manner as to present a clear and complete portrayal of the submarine relief. In general, the distribution of soundings depends on the scale of the chart, the number of shoals, and the bottom configuration.

Auxiliary information such as the chart title, geographic names, reference notes, data for magnetic compasses, cable and pipeline locations, and special anchorage or danger areas, is then added.

Included in the compilation material are survey data and information received from other agencies and miscellaneous sources.

FIGURE 7.—All these records were used in making a single nautical chart.

Reports of wrecks, uncharted reefs, and shoaling on bars and in channels must be represented on the nautical chart to provide the maximum safety for navigation.

After the chart manuscript has been compiled, it is then verified and administratively approved for reproduction.

The published chart is a culmination of geodetic, topographic, hydrographic, and cartographic endeavor. Our engineers firmly believe that the ultimate in professional cartographic work is contained in the

nautical chart—demonstrated by the verification and review of the survey data, and in the skill and accuracy of applying that data to the chart manuscript.

There is an important reason for the exacting requirements involved in this work. The mariner, more often than not, is beset with dangers after he makes his landfall—some marked, some unmarked, but very few visible from the bridge of his ship. Accurate portrayal of these features on the chart is necessary for safe navigation.

When the consequences of a ship disaster, accompanied by possible loss of life and property are fully realized, the responsibility involved in the evaluation of the surveys and their component data is obvious. Our engineers accept that responsibility.

The Thirteenth Annual Meeting

The Thirteenth Annual Meeting of the American Congress on Surveying and Mapping will be held on March 23, 24, and 25, 1953, at the Shoreham Hotel, Washington, D. C. "Map Uses" and "Engineering Surveys and Maps," which provide the engineering information essential to economic planning and development, will be the main themes of the meeting. Emphasis will be placed upon meetings of the technical divisions, open discussions of papers and panels, social functions for members and guests, and special programs for the ladies.

A luncheon for the introduction of foreign dignitaries will be featured on the opening day, following official opening of the exhibits. The plenary session on Monday, March 23, will concern "Maps—the Necessary Medium to World Progress," "Nautical Charts," and the map needs of the aviation industry. Meetings of the Topography and Control Surveys Divisions will follow. The exhibits, which will be the most extensive ever assembled at an annual meeting, will be open Monday evening and a cocktail and get-together party will follow.

Tuesday morning, March 24, will be marked by sessions of the Property Surveys, Cartography, and Instruments Divisions. A plenary session in the afternoon will include recommendations from the panel on "Selection of Contour Intervals," "Waste in Boundary Litigation and Preventive Measures," a discussion on whether changes are needed in surveying instruments, and a symposium on "Map Use," which will feature a report on the findings of the committee.

Wednesday morning will be devoted to technical division sessions, while in the afternoon a plenary session on such topics as "What Surveying Means to Industry," "Locating Hurricanes by Radar," "Education in Surveying and Mapping," the relationship of professional and technical societies to good government, and the annual business meeting, to be followed by the gala ACSM dance. The next morning, Thursday, March 26, the Board of Direction will meet.

The regular registration fee of $2.00 will be charged; wives and lady friends of members are requested to register, although they need not pay any fee.

Exhibits will be open to the public without charge during the meeting and from 6 until 9 the evening of Monday, March 23.

Role of the Land Surveyor in Title Insurance

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THE EXISTENCE of individual rights and interests in separate and distinct parcels of landed property has been recognized from the earliest period of which we have been able to obtain authentic account. In the early days of recorded history, possession was the only evidence of these rights and interests, and it was only later, when the art of writing became common, that the practice of transferring such rights and interests to real estate by a written instrument became common practice. Actually, it has only been since the adoption of the statute of frauds in England in the 17th century that such transfers have been required to be made in writing.

The evidence of these rights and interests in real estate is what we now refer to as the *title*. This evidence, or title, consists of two elements: (1) The chain of events shown by legal documents of various kinds, such as deeds, wills, and judgments or decrees in lawsuits, which bring down the history of the various transfers of the ownership of the property to the present time and vest the right of ownership in a definite person or persons, and (2) possession or the actual physical appropriation of the land itself, to the exclusion of all other persons, as evidenced by visible structures of a more or less substantial character, such as buildings, fences, and other enclosing devices.

The system of examining titles has developed through the centuries from reliance on possession of the land alone, through physical transfer of the documents of title from one person to another, through reliance on the warranties and covenants in the deed, through the abstract of title, which is a history of all transactions involving the particular parcel of land and requiring the opinion of an attorney, to the modern method of title insurance.

Title insurance is an opinion by an insurance company as to the validity of a title, backed by an agreement to make that opinion good in case it should prove to be mistaken and loss should consequently result to the party insured. In the development of title insurance, the protection afforded the insured was at first limited to evidence which could be ascertained from an examination of the public records. Matters that could be determined only by an actual survey and physical inspection of the property, such as questions of location, boundary, area, overlaps, and encroachments, were not covered or insured against.

With the growth of large urban areas and consequent increase in land values and the advent of life insurance companies in the field of mortgage loans, title insurance companies were requested to insure against such matters. As a result, they began to issue a new form of policy known as the A.T.A. policy, commonly referred to as "full coverage title insurance." An owner or mortgagee under such a policy may obtain title insurance which affords him protection both as to the validity of the title as evidenced by public records and as affected by matters which may be determined only by a survey and inspection of the property.

In issuing such policies, title insurance companies must have some basis upon which to determine the validity and limitations of the title, for title insurance is not mere guesswork nor is it a wager. It is based on careful examination of the muniments of title and the exercise of judgment by skilled conveyancers. For the validity of the title as disclosed by public records, the title insurance company relies on the opinions of attorneys based upon their own examination of the records or, if the title insurance company has its own title plant, upon the opinions of the attorneys on its staff. For those matters affecting the title which can be determined only by survey and inspection of the property, the title insurance company

relies upon the professional skill of the certified land surveyor. Only after having complete information with regard to both of these elements is the title insurance company in a position to determine whether to insure the validity of the title and what features of the title it cannot insure and must except from the provisions of the policy.

Inasmuch as the survey is of such prime importance in title insurance, we come now to the question of the matters to be shown on a survey. It must be borne in mind that while a survey is important to the title insurance company, it is equally important to the prospective purchaser of the property and to the lender who is making a loan on the security of it. It should, therefore, be comprehensive enough to cover all matters that are of special interest to these several parties. Although each individual lender and title insurance company has its own requirements as to matters which should be shown on the plat of survey, the surveyor will ordinarily become familiar with them as he continues to work with the various lending institutions and title insurance companies. There are, however, certain matters which all surveys of urban property should indicate. These may be grouped as follows:

(*1*) *Location and Dimensions of the Lot.*—The survey should describe the property by lot, block, and section number, as the case may be, as well as by subdivision name, and should show all natural and artificial boundaries such as streams, streets, or railroads. The lot numbers of the adjoining property or properties should also be shown and, in the case of interior lots, the measured distance to the nearest side street. The house number and the name and width of the street or streets on which the lot fronts should likewise be indicated.

The survey should show the area of the lot and the measured lengths of all lot lines and if there is any discrepancy between such lengths and those shown on the recorded plat of subdivision, this difference should be clearly indicated.

(*2*) *Location of Improvements.*—The survey should show the location of all improvements on the property, including buildings, garages, and sheds, as well as any building set-back lines shown on the recorded plat of subdivision. Not only should the locations of the walls of the main building be shown, but also the locations and dimensions of porches, stoops, bay windows, and fire escapes. The measured distances between buildings and property lines should also appear. This information is of the utmost importance to the title insurance company because, in most cases, it is called upon to insure that none of the improvements on the property violate the recorded set-back lines or building restrictions affecting the property.

(*3*) *Location of All Easements Known or Apparent From Inspection.*—The survey should show the location of all sidewalks, paths, driveways (particularly joint driveways), telephone, telegraph, and electric-power poles and wires on or crossing the property as they may indicate the rights of others in the property which are not matters of record. In the same category are party walls. These items should be indicated with reference to the property lines.

The surveyor should check for sewer and water lines in the proper governmental departments and should indicate their position on the survey. Their existence may indicate an easement in some other person to maintain such sewer or water lines across the property and may also affect the use to which the property can be put.

(*4*) *Location of All Fences and Hedges.*—The survey should indicate the locations of all fences and hedges because they denote the extent of the possession of the parties, and whether they are located on the property in question or on adjoining property should be indicated.

(*5*) *Encroachments and Overlaps by Improvements.*—The survey should cover any encroachments or overlaps of the buildings on the property and on the adjoining property to ascertain whether they constitute an encroachment either by or against the property in question.

With respect to property located in rural areas, the survey should show, in general, the same matters applicable to urban property except, of course, for those matters which are peculiar to urban property by reason of the recorded plat of subdivision. In the main, the location and dimensions of the property are the most important factors in a survey of rural property. The beginning point should be clearly indicated and should be capable of being definitely located on the ground either by calls or ties to monuments of record. Preferably, the boundary lines should be tied to lines of adjoining owners as they appear in descriptions of record. A monumented line such as "thence with the line of John A. Doe" is perhaps the safest way of identi-

fying a boundary line as it eliminates any possibility of a gap or overlap.

A description based on such a survey is safer and more certain because the tie to monuments will generally prevail over courses and distances. Particularly to be avoided are descriptions which tie the boundaries to the parcel being described, such as "beginning at a point which is the northeasterly corner of the property described and running thence south 42° 30′ east 198 feet to the southeasterly corner of the property being described," etc.

Space does not permit a discussion of all the factors which enter into a survey or the reasons for their inclusion.

The most practical test for the surveyor is to place himself in the position of a purchaser, lender, or title insurance company and try to depict on the survey all matters that each of these parties would be interested in knowing about the property.

Some title insurance companies have approved lists of surveyors whose work they will accept, just as they have approved lists of attorneys whose examination of titles they will insure. Others accept the work of any local certified land surveyor. In either case, it may be assumed that, if the placing of an order for a survey is at the discretion of the title insurance company, it will naturally turn to that surveyor whose work has proved most satisfactory.

The development and growth of title insurance has contributed greatly to the increased demand for the services of the land surveyor. A great opportunity is presented for closer cooperation between land surveyors and title insurance companies in correlating their mutual responsibilities in this field of modern title examination.

The Application of the Graphic Arts to Field and Office Problems in Surveying

By PROF. HARMER A. WEEDEN

BUCKNELL UNIVERSITY

DURING the past decades the time allotted to surveying in the civil engineering curriculum has been constantly reduced. A nation-wide study by Prof. Russell Brinker in 1949 shows that the present range of credit hours required in American colleges and universities in surveying is from 1 to 24 credit hours, with a mean value of 11.4 credit hours. Hence it must be recognized that all the teaching in these few hours must be effective. It is my hope to present in this paper several ideas through which secondary objectives as well as primary objectives may be attained. As one of the objectives is teaching fundamentals—the outline around which this paper is built is an outline of the scientific method. Should this paper fall into the hands of a student reader, it might serve as an example of the basic approach of the scientific method.

For some time the writer has experienced a need for streamlining in several aspects of his teaching in the field of surveying and transportation. Two specific examples of items important enough in themselves to merit a place in the curriculum are plane-table surveying for topographic mapping and the art of comprehensive report writing. Academically they fall in a fringe zone in that they are important applications of basic principles, but do not quite justify enough time to make for full proficiency or even nearly full proficiency on the part of the student engineer. Interestingly enough, both these topics have an industrial equivalent where they fall in a fringe zone for economic reasons. Some mapping projects are not large enough to justify the application of photogrammetric methods of the Kelsh Plotter, the Brock, or Multiplex process for the economical solution of a map need. A good example would be a route relocation of limited extent, perhaps 5 or 10 miles in length, requiring only limited elevation information, where the established methods of transit and stadia surveying or planetable mapping do not seem to be sufficiently rapid and inexpensive. The same condition is found to exist in the production of a limited number of copies of an engineering report including maps, diagrams, photographs, and text—a report that, in addition to its engineering significance, must be made lucid to a number of nontechnical readers. The commercial methods of printing and illustrating are beyond the limited budget of the authors.

The difficulty can be stated in the form of a question: What method of producing map manuscript and written manuscript, with flexibility in the matter of alterations, might lend itself to the economical solution of this academic and industrial dilemma? One suggested solution is the application of the graphic arts. Both the Eastman Kodak Company and the Ozalid Division of General Aniline and Film Corporation produce sensitized materials with definite applications in the field of surveying and mapping. Several direct applications are described as evidence in the rational elaboration of this idea.

The writer's attention was first directed to this problem in the search for a streamlining of route surveying techniques which would not involve the acquisition of expensive photogrammetric equipment. Being photography minded, the avenue of graphic arts seemed a likely source worthy of investigation.

Presented at the Twelfth Annual Meeting, American Congress on Surveying and Mapping, Washington, D. C., June 11–13, 1952.

An appendix to the original paper contained illustrations of many of the items that the author describes, but which are not reproducible in the Journal.—Ed.

By correspondence it was learned that the Chicago, Burlington, and Quincy Railroad had made use of graphic arts in the solution of a track relocation problem, and that this project was described in detail in *Railway Age,* July 15, 1950. Graphic arts were used at several stages of the planning and location phases of the work:

> The project over all covered some 49 miles of new single track location, whereas only 24 miles were covered by United States Geological Survey quadrangle maps at scales varying from 1:24,000 to 1:62,500 and with contour intervals of from 20 to 50 feet. These were reproduced by photostating and were brought to a common scale. The gaps were filled with photostat copies of the Public Roads Administration's general highway and transportation maps, scaled to fit but without contours. These photostats were fitted together to form a mosaic four feet by nine feet. Elevations on the mosaic were shown by color tinting in the form of bands. A draft film overlay with a matte surface was mounted on the mosaic to enable the laying out of various projected lines without damaging the mosaic. When the preliminary line for the new route was singled out and projected on the mosaic, photostatic copies were made and sent to the field as a guide for the locating engineer.

The next stage of this mapping project is the most fertile source of ideas to be borrowed and adapted to the individual problems of the practicing surveyor or teacher. With the preliminary line photostats in hand the locating engineer is faced with the problem of securing a planimetric map with limited elevation information. An aerial photograph with certain dimensional data supplied by field work may be substituted for the usual topographic map. It is at this stage that the Burlington investigated the more recent developments in the graphic arts field.

The following digression serves to highlight to the surveying profession the features of the most readily available graphic arts materials. Eastman Kodak Company produces a line of silver sensitized materials that have a wide variety of properties and uses. The chief advantage of these Eastman products is the sharp, black, permanent line produced in the varying copy processes. Limiting the consideration to the Kodagraph series of films, papers, and cloths, these may be grouped according to the following uses:

1. Those for use with blueprint and direct process machines and vacuum frames
2. Those for use with contact photocopy equipment
3. Those for use with enlargers, projection printers, and process cameras.

The first group are the Autopositive papers, cloths, and films, which have high contrast, are evenly translucent, and print directly to a positive when starting with a translucent original. If the original is opaque, reflex printing techniques are used, which yield a left-to-right negative, yet positive with respect to gray tones. When printing from this type of Autopositive copy no problem is involved because the base material is itself translucent, hence it is only necessary to reverse the master in a left-to-right sense, thus yielding a positive copy. The materials can be handled in ordinary room light, and are wet-processed in the usual order of develop, rinse, fix, and wash before drying. Autopositive materials actually increase contrast and will render copies that are sharper than the originals. They can be used as intermediates in producing additional copies; moreover, they are subject to easy change through the use of chemical bleaches or in the newer types by simply moistening and erasing.

The second group consists of contact papers which are of greatest value in the production of multi-copies of either office correspondence, reports, or drawings where advantage can be taken of already owned contact printers.

The third group renders sharp-line copy even when using projection equipment. It must be realized, though, that all these Kodagraph materials are limited in their ability to produce continuous gray tones. This is significant when aerial photographs are to be reproduced. It is then necessary to use a screened film positive. When the copy obtained by any of the above processes is on translucent paper or film, it can be used with standard blueprint or Ozalid

equipment to mass produce copies on less expensive paper bases.

The Ozalid Division of the General Aniline and Film Corporation produces a line of sensitized papers, cloths, foils, and films which produce copy of varying colors. The chief advantage of this two-stage process of expose and dry-develop is the quickness with which prints are available for use. Ozalid sensitizes all its materials with diazo salts and couplers which are developed and fixed in heated aqua ammonia vapors. Ozalid papers and films make good intermediates which can be easily altered through the use of chemical eradicators.

Ozalid produces a dry photo paper for the reproduction of continuous-tone photographic subjects. This is especially valuable for the reproduction of aerial photographs. The starting point for this process must be a positive, translucent original. This can be produced photographically from a glossy print with only slight loss of photographic detail. Half-tone screening can be resorted to here, but it is not necessary.

Several Ozalid accessories are worthy of mention; namely, correction fluid, opaque typewriter ribbons, and transparentizing solution, the names of which clearly outline their use. Both Ozalid and Eastman transparent films can be printed to produce overlays which will serve to show several alternate solutions on one basic layout; or to accentuate some detail in a photo or drawing. For further information on either Ozalid or Eastman products, their technical staffs have prepared very readable catalogs or brochures which are easily understood, even by non-photographically minded readers.

Now returning to the railroad location problem, the Burlington arranged to obtain positive scale film enlargements of aerial photographs from the Production and Marketing Administration of the U. S. Department of Agriculture. The aerial negatives at a scale of 1:20,000, or 1 inch equals 1,667 feet, were used, with rectification to produce enlargements at a scale of 1 inch equals 400 feet. The Burlington was able to get the Production and Marketing Administration to cooperate in producing diapositives, rectified to scale, based on ground control furnished by the Burlington, which also furnished the film. This is a service that the Production and Marketing Administration does not generally furnish to the public. The enlargements were made on Kodak Translite film so they could be reproduced on conventional drafting room equipment. This film differs from Autopositive film in that it yields a positive image from a negative and is designed to reproduce continuous gray tones. A screened film positive is an alternative here which produces excellent detail. This type of material is more satisfactory for photographic reproduction, whereas the Autopositive material is more useful in the reproduction of line drawings. The Translite film, however, has a matte surface so that penciled information may be added to the film diapositives after they have been made.

Reproducing these film positives on either Ozalid standard paper or other direct-process papers, provides the location engineer in the field with a cheap paper copy of the topography through which he will be running his line. He can then select a point of beginning that will tie in with the proposed over-all route location, resect himself on the aerial photographic print, and choose his first tangent. The preliminary line is now underway and can be plotted along with the field work as it progresses—indeed, planetable would be the ideal instrument to use here. Profile data along the preliminary line would be obtained, as well as the section, township, and range numbers; names of streams, rivers, towns, highways, and other points; and the property lines would be located and the names of the property owners obtained.

Digressing again for a moment to look at the academic problem of instruction in planetable surveying, one might consider the following advantages of learning to use the planetable in conjunction with a copy of an aerial photograph. In the first place, the engineering trainee is confronted with a picture of the physical reality around him rather than a blank sheet of paper.

Hence, it is much easier for him to grasp the concept of resecting himself for location at a particular point. He can study in advance on the photograph the topographic information that he should tie in, so that by judicious selection of particular control points for line, or for topography, the amount of leg work on the part of the rodman is minimized. It might also be pointed out that the photographic print can be used effectively by the planetable party in choosing a route that will not only fit the topography but will also avoid adverse soil conditions, such as excessive wetness, poor drainage, or troublesome rock outcrops. These are only a few of the advantages of using photographic prints—many more items could be cited.

When this phase of the field work was completed the field prints with the surveying information on them were returned to the office of the chief engineer, where the centerline and the right-of-way required for the new road were plotted in pencil on the matte surface of the Translite film positive. The profile information was plotted on transparent profile paper. On this profile the vertical alignment was then chosen and plotted to correspond with the horizontal alignment. The completed photographic map and the penciled profile were taped together and the combined plan and profile was reproduced on Autopositive film in the manner already described. Prints of the selected alignment and profile were sent to the construction engineer and the general land agent, both of whom were most enthusiastic over the valuable aid provided. The land agent's abstract work for the purchasing of the necessary right-of-way was much simplified, and land owners had no difficulty in reading the prints and in visualizing how the construction of the railroad would affect their property. This was true because rural persons were already more or less familiar with the photographs of the Agricultural Adjustment Administration in connection with crop control.

Another technique was developed and used in preparing the lease plans. An 8½- by 14-inch opening is cut in a piece of paper, leaving a surrounding border several inches wide. Transparent cellophane is taped over this opening. In preparing the lease plans the draftsman simply positions the paper frame on the original plan of the area, locating it so that the properties covered by the lease plan appear within the transparent area. A directional marker and the typewritten description of the property involved are pasted on this transparent cellophane overlay. Dimensions, distances, and other pertinent information are lettered on the cellophane window. After the necessary notations have been made on the overlay, the original and the overlay are placed in a vacuum frame and a sheet of 8½- by 14-inch Autopositive paper or film is placed face down on the window. The paper or film is exposed and processed, yielding an intermediate which shows the original photographic image plus the overlay and the typewritten material, and from this intermediate any number of Ozalid prints or other direct process paper copies of the lease plan may then be quickly made. It is to be noted that retracing is eliminated in the preparation of these plans. This same method can be used in the restoration of worn and damaged drawings.

There is only one master copy of the plan profile sheet; but if numerous copies are desired, they can be made faster if intermediate copies are first made. These can be made on Eastman's Transparent Autopositive Film, or on an Ozalid intermediate paper or foil. These several intermediates can then be used as "masters" from which several copies can be reproduced simultaneously, assuming that there is room for more than one copy at a time in the printing machine or that several machines are available.

Map users are sure to wonder about the dimensional stability of the materials described. Best results are obtained by using film. Eastman Kodak Company provides the data shown in tables 1 and 2.

The same materials are available to the Ozalid Company so it may be assumed that comparable values are obtainable. Information is not supplied for papers because

the variables in production and use are too numerous to control with any degree of success.

Numerous other applications of the use of graphic arts aids could be cited. It may be enough to direct the reader to the Ozalid Company's Field Aid, E-1-748, entitled *Ozalid Expedites Highway Planning,* or to Eastman's pamphlet entitled *New Short Cuts and Savings.* The former documents how the Minnesota Highway Department has applied the techniques outlined above to reduce drafting time per mile of highway by 8 days. The latter publication cites the advantageous use of Autopositive paper in the drafting rooms, reproduction departments, and shops of several well-known large industrial concerns, and more particularly the Virginia State Highway Department.

The oil industry is, perhaps, one of the most well-rounded users of graphic arts aids in its over-all engineering problems. The Ozalid suppliers are able to list 15 different applications. In addition to the mapping uses outlined above, transparent overlays are used to a greater extent. Transparent film overlays with lines accentuating lease areas or geologic structure greatly facilitate the understanding of property maps and geologic structure. These techniques are most successfully illustrated in a film entitled "A New Look for Oil" prepared by Geophoto Services of Denver, Colo. Its presentation of the application of graphic arts is unsurpassed. One aspect of this film most valuable to a teacher is the step-by-step process development of a reconnaissance report, and its message on report writing should not be disregarded.

One of the miracles academic teachers are supposed to work is that of inculcating on the student an ability to write a good report. A written report is always enhanced if it is well illustrated and neatly set up typographically. Because of its versatility Ozalid lends itself competitively in this field. Copy prepared on a translucent paper with Ozalid opaque typewritter ribbon, or using an ordinary ribbon plus a hard carbon backing, or special Ozalid orange carbon, will print a neat dark type on a white background. Using the same printing equip-

TABLE 1.—*Kodagraph Topographic Sheeting (thickness 0.00825 inch)*

	Differential change between length and width	*Average change in length and width*
Humidity coefficient of linear expansion per 10% relative humidity (at constant temperature)	0.01%	0.05%
Thermal coefficient of linear expansion per 10° Fahrenheit (at constant relative humidity)	0.01%	0.04%
Permanent shrinkage (from accelerated aging tests)	0.05%	0.12%

TABLE 2.—*Kodagraph Autopositive Film (cellulose acetate butyrate, 0.0055 inch thick)*

	Length	*Width*
	(Thousandths of an inch per foot)	
Humidity coefficient of linear expansion per 10% relative humidity	8	9
Thermal coefficient of linear expansion per 10° Fahrenheit	4	5
Processing shrinkage	4	5
Long time aging shrinkage (1 year at 70° F., 50% relative humidity)	8	9

(The aging shrinkage includes processing shrinkage.)

ment it is possible to produce dry photo copy of photographs, transparent overlays to accentuate photo detail, or to illustrate alternate layouts on one basic plan. Ozalid offers a choice of colors for printed copy, as well as for line drawings and overlays. Ozaplastic, which is a plastic-coated paper that develops to a jet black line on a lustrous white background, can be used in preparing a waterproof, oilproof cover for a report, if it is likely to receive rough treatment. The use of Ozachrome Foil color separations makes it possible to include full-color illustrations in a report or display. Color work in Ozalid is an exacting task and will require practice before satisfactory results are forthcoming.

It should be impressed upon students that, in addition to presenting facts, a report can have a secondary effect upon the reader—create a favorable impression, or put the reader in a receptive mood. The forcefulness with which the text is written can be totally destroyed if it is faintly printed, or worse, presented on a low grade medium. While this may be deplored, it is nevertheless true. Hence, students should be urged to consider the medium on which the report is to be presented. The line quality of diagrams, the clarity, crispness, or pep of photographic illustrations are factors to be carefully considered.

Cost is too important a factor to be ignored, but it is difficult to arrive at the net cost of producing a successful report. An alternative to Ozalid or Kodak material might be photo-offset printing. The illustrative material and its quality will influence this decision. It may be that a slick paper fancy printing job is called for, but this is not usually the case in an engineering report. A comparative cost analysis of Ozalid and Kodak reproduction of a report would, of course, depend not only on the number of copies desired but also on the extent to which labor costs could be reduced by taking advantage of office help and office typewriters, and producing the final form on already available equipment. Most up-to-date engineering offices have some form of copying equipment which can be used. Perhaps the writer should clearly state here that he strongly urges the above reasoning in reverse—that is to say, these are reasons why one should get good copy equipment or make use of the services of a firm in the business.

The advantages of the foregoing applications of graphic arts in teaching methods, as well as in industrial applications, compels one to seek out ways of putting the techniques to use. Among the applications which the writer intends to institute in teaching are:

1. The use of Ozalid prints made from film diapositives at a scale of 1 inch equals 200 feet or 1 inch equals 400 feet in teaching the use of the planetable.
2. The preparation of field data sheets as well as compilation sheets on translucent forms of original design to facilitate classroom distribution of group data—such as base line measurements, triangulation data, stadia notes, and cross-section notes.
3. The preparation of Ozalid dry photo copies of aerial photographs for use in illustrating reports.
4. The preparation of Ozalid copies from screened film positives on which to compile control data, both horizontal and vertical.
5. The encouragement of the reproduction of the reports of students who produce definitely worthwhile papers as a part of required work in highways.
6. The use of graphic arts in the preparation of publicity, reports, newspapers, and the like, in the conducting of A.S.C.E. student chapter affairs.
7. The production of multi-copies of drafting room standards.

Readers are cautioned that photo interpretation cannot be taught satisfactorily by using dry photo copies. Experience has shown that, at a scale of 1:20,000, the loss of detail prevents refined interpretive techniques, such as soil and geologic analysis which depend on the successful interpretation of minor tone variations.

The writer hopes that he has not seemed to try to sell one process over another. The equipment already on hand may lead one to a definite choice between Eastman and Ozalid products. A thorough investigation of both should be made, bearing in mind the desired end product as well as the pro-

duction steps. The writer, however, implores the reader to consider seriously how graphic arts materials can be put to full use in solving his own particular problems. A most desirable result would be the stimulation of an exchange of ideas between the men in the business, which no doubt would bring forth much in this field that has not been mentioned herein.

To sum up then, graphic arts materials should receive the earnest consideration of anyone teaching or working in surveying when it is desirable to:

1. Reduce retracing expense.
2. Reclaim old drawings.
3. Assure exact copy—to avoid costly reading errors in the shop.
4. Revise old drawings.
5. Produce photographic intermediates quickly and at low cost.
6. Save time when drawings are to be combined.
7. Save time in blue printing or direct printing operations.
8. Protect valuable originals.
9. Eliminate costly field procedures where substitution of a paper copy of photo map is satisfactory.
10. Produce transparent overlays.
11. Prepare lucid economical reports.

Surveying and Mapping Short Course

A SHORT COURSE consisting of five sessions of lectures and papers on subjects of vital importance to land surveyors was conducted by the School of Civil Engineering, Georgia Institute of Technology, Atlanta, Ga., February 5–7, 1953.

The course was sponsored by the Georgia Association of Registered Land Surveyors (GARLS). The important, but far too often neglected, legal phase of land surveying education was emphasized in lectures by four experts in that field who spoke on "Legal Aspects of Surveying," "Mortgage Loan and Property Boundary Surveys," "Relationship of Surveyor and Title Company," and "Why Records Should be Filed." Other papers and lectures included "Chaining and Angle Measurements," "Polaris and Sun Observations," "Methods of Making Small Topographic Maps," "Grid and State Plane Coordinates," "Subdivision Planning," "Value of Topographic Maps for Architectural Use," "Plat and Map Reproductions," "Recommended Fees for Surveys," and "Selection and Care of Instruments."

—F. S. BORDEN

American Society of Photogrammetry Holds Nineteenth Annual Meeting

THE Nineteenth Annual Meeting of the American Society of Photogrammetry was held at the Shoreman Hotel in Washington, D. C., on January 14, 15, and 16, 1953. More than 800 registered members and guests were in attendance.

An international flavor was lent to the proceedings by the extensive participation of the Canadian delegation in the technical sessions. Papers covering a wide range of photogrammetric subjects were presented; the major emphasis, however, was on the subjects of photo-interpretation and Arctic mapping.

Among the many interesting exhibits were two new photogrammetric instruments: the ER-55 projector and the stereopontometer. The ER-55 projector for stereoscopic plotting utilizes an unsymmetrically-positioned ellipsoidal reflector for condensing the light rays, with the light source placed at one focus of the ellipsoid and the projecting lens placed at the other focus. The stereopontometer is a new device for aerial triangulation of convergent oblique photography.

The following officers of the Society were elected for 1953: Alfred O. Quinn, *President;* Arthur C. Lundahl, *First Vice President;* and John I. Davidson, *Second Vice President.*

Plans were announced for a fall meeting sponsored by the Central New York Section of the Society to be held at Rochester, N. Y., in September 1953.

Vertical Accuracy of Topographic Maps

By MORRIS M. THOMPSON and CHARLES H. DAVEY
U. S. GEOLOGICAL SURVEY

THE DEBATE on the subject of map accuracy has been continuing for a good many years. Assertions are repeatedly made by one source or another (but mainly by map makers) that United States accuracy standards are too high, that we ought to lower our accuracy and increase our quantity, or that we are wasting money by maintaining impractical standards. This problem was brought into sharp focus at the Twelfth Annual Meeting of the American Congress on Surveying and Mapping in June 1952 by the panel discussion on "Selection of Contour Intervals."[1] It is appropriate to take a good look at our accuracy standards to make sure that we know what they mean and that we are all talking about the same thing. This preliminary study is neither exhaustive nor conclusive and certain assumptions have been made that may by open to debate. However, it is presented at this time to stimulate constructive thinking on this controversial subject.

THE EXISTING SPECIFICATION

The accuracy specifications adopted in 1941 by the principal map-using and map-making agencies of the Federal Government contain the following statement regarding vertical accuracy:

> Vertical accuracy, applied to contour maps on all publication scales, shall be such that not more than 10 percent of the elevations tested shall be in error more than one-half the contour interval. In checking elevations taken from the map, the apparent vertical error may be decreased by assuming a horizontal displacement within the permissible horizontal error for a map of that scale.

We are all familiar with the first part of this specification—"not more than 10 percent of the elevations tested shall be in error more than one-half the contour interval." Unfortunately, the first part of the specification is frequently mistaken for the whole specification. It makes a world of difference in the accuracy requirement when we add the second part—"the apparent vertical error may be decreased by assuming a horizontal displacement within the permissible horizontal error for a map of that scale." It is the purpose of this paper to spell out the meaning of the complete specification as applied to the conditions normally encountered in practice.

ACCURACY IN TERMS OF STANDARD DEVIATION

Let's look again at the first part of the specification and restate it as "90 percent of the elevations tested shall be correct within one-half the contour interval." Although there is nothing wrong with this terminology, it is desirable, for comparison, to convert the statement to universally accepted mathematical language; so let us state the allowable error in terms of the standard deviation.

No one who can perform simple arithmetical computations need be alarmed at the mention of "standard deviation." Mathematically, it is expressed as follows:

$$d = \left[\sum \frac{e^2}{n}\right]^{1/2} \qquad (1)$$

where d = standard deviation
e = error at each point tested
n = number of points tested.

All we need do to find the standard deviation of a number of observations is to square each error, add up the squares,

Presented by Mr. Davey at a joint session of the Technical Division on Cartography and the Technical Division on Topography, American Congress on Surveying and Mapping, Washington, D. C., November 6, 1952.

[1] Published in the October–December 1952 issue of SURVEYING AND MAPPING.

divide by the number of observations, and take the square root of the quotient. The result is variously known, in different countries, as mean error, mean-square error, or root mean-square error. We prefer to use the term "standard deviation" as being most descriptive of its significance.

According to error theory, 90 percent of the accidental errors should not be larger than 1.66 times the standard deviation d. Inasmuch as our specifications require that 90 percent of the elevations tested shall not have errors larger than half a contour interval, it follows that the allowable standard deviation d_o that is equivalent to the first part of our specification is one-half the contour interval divided by 1.66 or

$$d_o = \frac{C.\ I.}{2 \times 1.66} = 0.3\ C.\ I. \qquad (2)$$

These standard deviations would be as follows for commonly used contour intervals:

TABLE 1.—*Allowable standard deviations*

Contour interval in feet ($C.I.$)	Allowable standard deviation in feet (d_o)
5	1.5
10	3.0
20	6.0
25	7.5
40	12.0
50	15.0
80	24.0
100	30.0

In order to make a comparison of the application of the present accuracy specification with that of an equivalent stated in terms of standard deviation, let us consider hypothetical tests of two compilations representing extreme but possible conditions. For simplicity only nine points have been included in the hypothetical test of each compilation and the possible effects of any allowable horizontal shift have been ignored. Table 2 is an analysis of the tests of the two compilations, the contour interval being 20 feet.

Table 2 represents unusual conditions, but these extreme conditions serve to illustrate the possibilities under the existing accuracy specification. Most people would agree that compilation B is the better map; it has a standard deviation of +3.4 feet, whereas compilation A has a standard deviation of ±10 feet. But what does our present accuracy standard tell us? All nine test points of compilation A are within half a contour interval, and we say that it tests 100 percent and the map passes with flying colors. Incidentally, if all the errors were 0 instead of 10 feet, the compilation would be graded as having exactly the same degree of accuracy: 100 percent of test points within half a contour interval. The magnitude of the errors within the half contour-interval allowance is given no weight whatsoever. Take compilation A a step farther and suppose that all the errors were 11 feet instead of 10 feet. The standard deviation would change by only 1 foot—from 10 feet to 11 feet. But the percentage of points within half a contour interval would change from 100 percent to 0 percent. By a change of 1 foot in the error found at each test point, the compilation bounces from the category of

TABLE 2.—*Compilation tests, 20-foot contour interval*

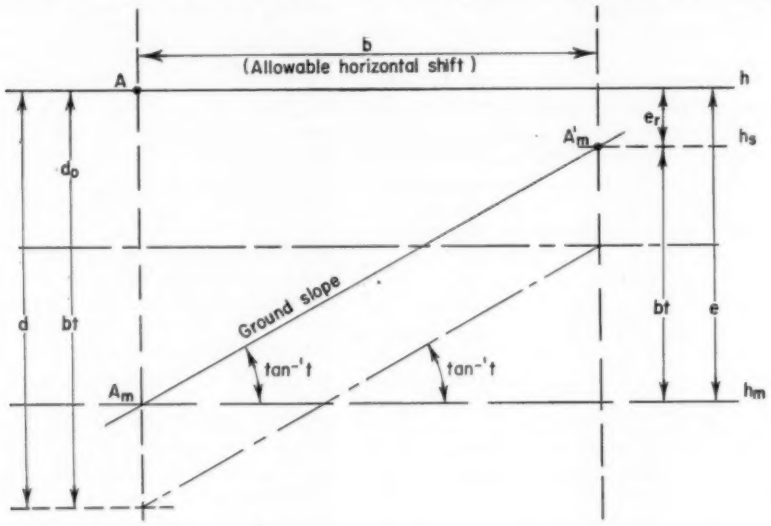
Point No.	Compilation A		Compilation B	
	e	e^2	e	e^2
1	+10 ft.	100	0 ft.	0
2	−10	100	0	0
3	+10	100	0	0
4	−10	100	−11	121
5	+10	100	0	0
6	−10	100	0	0
7	+10	100	0	0
8	−10	100	0	0
$n=9$	+10	100	0	0
Σe^2		900		121
$\Sigma e^2/n$		100		13.4
d		±10 ft.		±3.4 ft.
No. of points within ½ contour interval		9		8
Percent of points within ½ contour interval		100		89

the perfect compilation to the category of the worthless compilation.

On the other hand, compilation B, really a pretty good map with a standard deviation well within the theoretically allowable value of 6 feet, should be rejected, according to our present standard, because only 89 percent of the points tested are within half a contour interval. In summary, under our present standard we could accept the weak compilation A and reject the strong compilation B.

THE ALLOWABLE HORIZONTAL SHIFT

The standard deviations listed in table 1 represent the allowable vertical tolerances without taking into consideration the allowable horizontal shift. We must next consider the changes in these tolerances effected by the second part of the specification: "the apparent vertical error may be decreased by assuming a horizontal displacement within the permissible horizontal error for a map of that scale." What vertical error do we allow, then, when the shift is considered, if the tangent of the angle of slope of the ground has a value t? In figure 1, let A be a test point on ground which has a slope of t, where t equals the tangent of the angle of slope. A_m is the map position of A, in a profile view. If we are allowed to consider point A as being shifted horizontally on the map



Let A be a test point
h = true elevation of A, above datum
h_m = map elevation of A, above datum
h_s = map elevation of A, after shift

d_o = Allowable standard deviation without shift
d = Allowable standard deviation with shift
t = Tangent of slope angle at A

Then $h - h_m = e$, the observed error in map elevation of A
$h_s - h_m = bt$, the change in elevation resulting from shift
$h - h_s = e_r$, the residual error after shift
$d = \pm (d_o + bt) = \pm (0.3\ C.I. + bt)$

Example: Map scale 1/24000, b = 40', C.I. = 20' and t = 0.2
$d = \pm [(0.3 \times 20) + (40 \times 0.2)] = 14'$

FIGURE 1.—Effect of horizontal shift.

a distance b, its map position changes from A_m to A'_m and the map elevation is increased an amount bt. The error in map elevation for point A is e, and from inspection of the figure, we see that $e = e_r + bt$, and, therefore, e may be decreased to e_r. In terms of standard deviation, the maximum allowable value of e_r is d_o and the maximum allowable value of e is d, the total allowable standard deviation at A, considering the shift. We can therefore write the general equation:

$$d = (d_o + bt)$$

where $d_o = 0.3\ C.\ I.$, the standard deviation without allowable shift or

$$d = \pm\ (0.3\ C.\ I. + bt). \qquad (3)$$

Let us see how this formula works out in an actual example. Suppose we have a map publication scale of 1: 24,000, a 20-foot contour interval and an allowable horizontal displacement of 1/50 inch on the map at publication scale, or 40 feet of ground distance. Referring to table 1, we see that $d_o = 6.0$ feet for a 20-foot interval, and for a ground slope of 0.2, substituting in (3), we obtain:

$$d = \pm\ (0.3 \times 20) + (40 \times 0.2) = 14 \text{ feet.}$$

Suppose further that we determine by field check that the elevation at A is 12 feet too low on the map. In effect, the specifications permit us to assume point A to be shifted horizontally 40 feet on the map to position A'_m where we can read its map elevation h_s for comparison with the actual elevation h of A. Because of the ground slope of 0.2, the elevation at A'_m reads 8 feet higher than at A_m and the elevation error of 12 feet before shift is reduced to e_r, or 4 feet, after shift, which is less than 6 feet, the value of d_o. In effect, the 8-

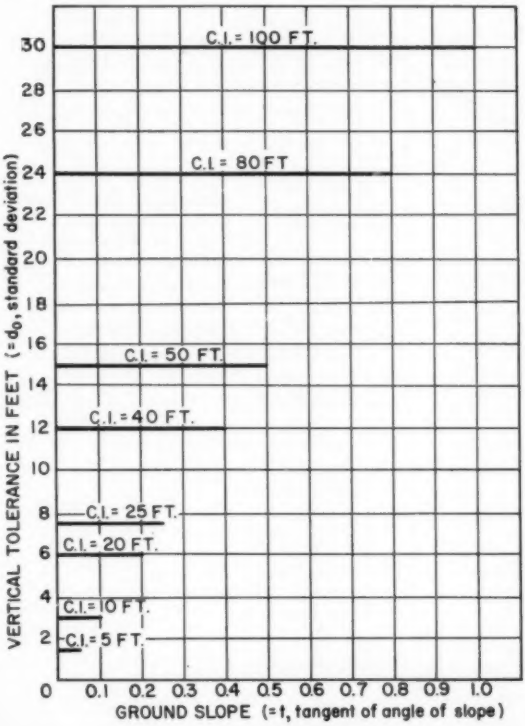

C.I. = 100 FT.
C.I. = 80 FT
C.I. = 50 FT.
C.I. = 40 FT.
C.I. = 25 FT.
C.I. = 20 FT.
C.I. = 10 FT.
C.I. = 5 FT.
VERTICAL TOLERANCE IN FEET (= d_o, standard deviation)
GROUND SLOPE (= t, tangent of angle of slope)
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30
EQUIVALENT SPECIFICATION:
90% OF TEST POINTS SHALL BE WITHIN $\frac{1}{2}$ CONTOUR INTERVAL
MAP SCALE: 1/24000
GENERAL FORMULA:
$d_o = 0.3$ C.I.

FIGURE 2.—Vertical tolerances without shift.

foot vertical difference due to ground slope gives us an allowable standard deviation of 14 feet at A, whereas it would be only 6 feet if the ground were level. In general, for a 20-foot contour interval at a 1: 24,000 publication scale, the tolerance is:

$$d = \pm(6 + 40\,t). \qquad (4)$$

If the horizontal shift were not allowed, the vertical tolerance, in terms of standard deviation, would be represented by figure 2. This figure is shown because some may be prone to overlook the allowable shift, which would lead to the erroneous conclusion that figure 2 represents the accuracy requirements. It is to be noted that in this figure the tolerance does not vary with the slope.

Strictly speaking, the allowable shift factor, bt, should also be expressed in terms of standard deviation. The horizontal accuracy specification states that not more than 10 percent of the points tested shall be in error by more than 1/50 inch or 1/30 inch, depending on the publication scale. The horizontal standard deviation would be, in theory, $\frac{40}{1.66} = 24$ feet, for a 1: 24,000 scale map. The theoretical equation for vertical standard deviation on a 1: 24,000 scale map with 20-foot contour interval would then be:

$$d = \pm\,(6 + 24t). \qquad (5)$$

This equation, however, does not con-

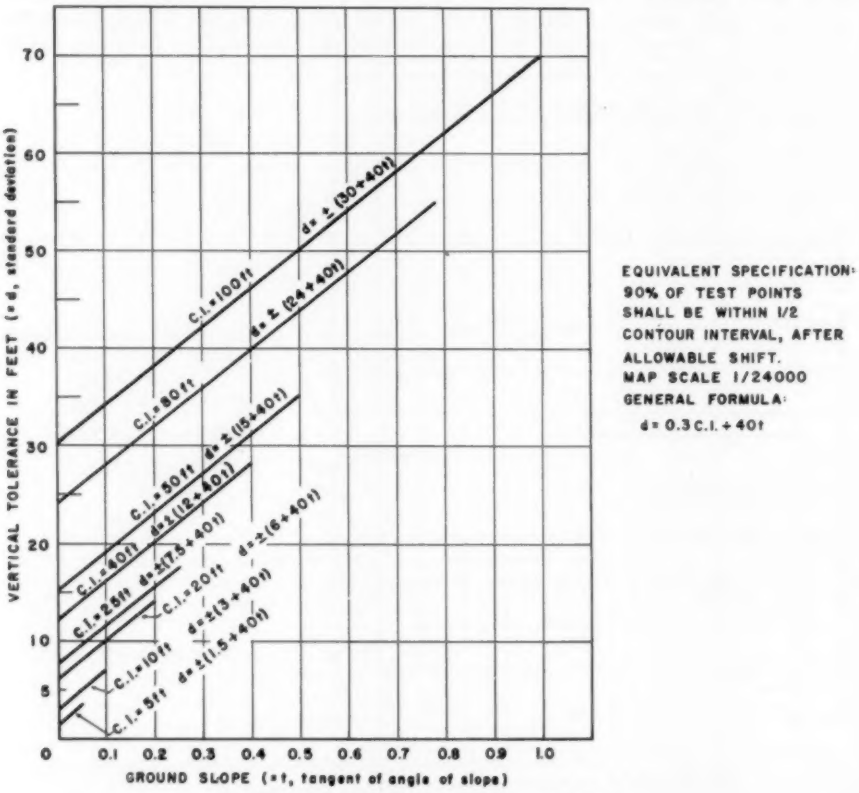


FIGURE 3.—Vertical tolerances with shift.

form to actual practice, for the customary interpretation of the horizontal specification is that the allowable shift of 40 feet is used in full when needed.

Figure 3 represents the tolerances, also in terms of standard deviation, which the specifications actually permit. The effect of the allowable shift on the vertical tolerance is strikingly obvious, becoming more and more important as the ground slope increases.

LIMITING SLOPES

The range of ground slopes covered by each of the plotted lines in figures 2 and 3 is limited by the normal relationships of contour intervals to ground slopes, as encountered in practice. For instance, 5-foot contours are not ordinarily used on a 1: 24,000-scale map where the angle of slope is 45°, that is, when $t = 1.0$. The practical ranges of slope were arrived at by assuming that the contour interval should be changed to the next larger if the average spacing of index contours on the map is less than a quarter-inch. If there are four intermediate contours, adjacent contours are then limited to a spacing of $\frac{0.25}{5} = 0.05$ inches. At a map scale of 1: 24,000, this is 100 feet. For the purpose of this study the choice of contour interval for 1: 24,000 maps has been limited, then, by the requirement that contours should be at least 100 feet apart, whatever the interval. From this requirement, we can determine limiting average ground slopes for the use of any contour interval.

TABLE 3.—*Limiting slopes*

Contour interval, feet	Limiting slope (= tangent of angle of slope)
5	0.05
10	0.10
20	0.20
25	0.25
40	0.40
50	0.50
80	0.80
100	1.00

Table 3 indicates limiting slopes for the more commonly used contour intervals.

A plot showing the relation of allowable vertical deviation to ground slope, for a given contour interval, has practical significance only for slope values which do not exceed the limiting value given in table 3, for that interval. Figures 2 and 3 are therefore plotted in accordance with this practical limitation.

It is interesting to note that, regardless of the contour interval, the standard deviation for zero slope is 0.3 *C. I.* Moreover, when the map scale is 1: 24,000 and the average ground slope is at the limiting value for the contour interval used, the allowable vertical tolerance is:

$$0.3\ C.\ I. + 40\left(\frac{C.\ I.}{100}\right)$$
$$= 0.3\ C.\ I. + 0.4.\ C.\ I. = 0.7.\ C.\ I.$$

Therefore, the plotted lines in figure 3 are not continued beyond a vertical tolerance of 70 percent of the contour interval.

TOLERANCE IN TERMS OF PERCENT OF CONTOUR INTERVAL

Figure 4 shows the vertical tolerance expressed in terms of the percent of contour interval. A rather curious circumstance is brought out by this figure: For a given ground slope, a higher percentage of tolerance is allowed for a smaller contour interval than for a larger interval. For example, when the slope is 0.2 and the contour interval is 20 feet, the allowable deviation is 70 percent of the contour interval, whereas for a 40-foot interval and the same slope, the allowable deviation is 50 percent of the contour interval. In terms of absolute error, however, the allowance is 14 feet for the 20-foot interval and 20 feet for the 40-foot interval.

COMPARISON WITH EUROPEAN STANDARDS

A comparison of American standards of vertical accuracy with European standards is useful for the purpose of determining whether there are any significant differences in the respective approaches to the subject of accuracy.

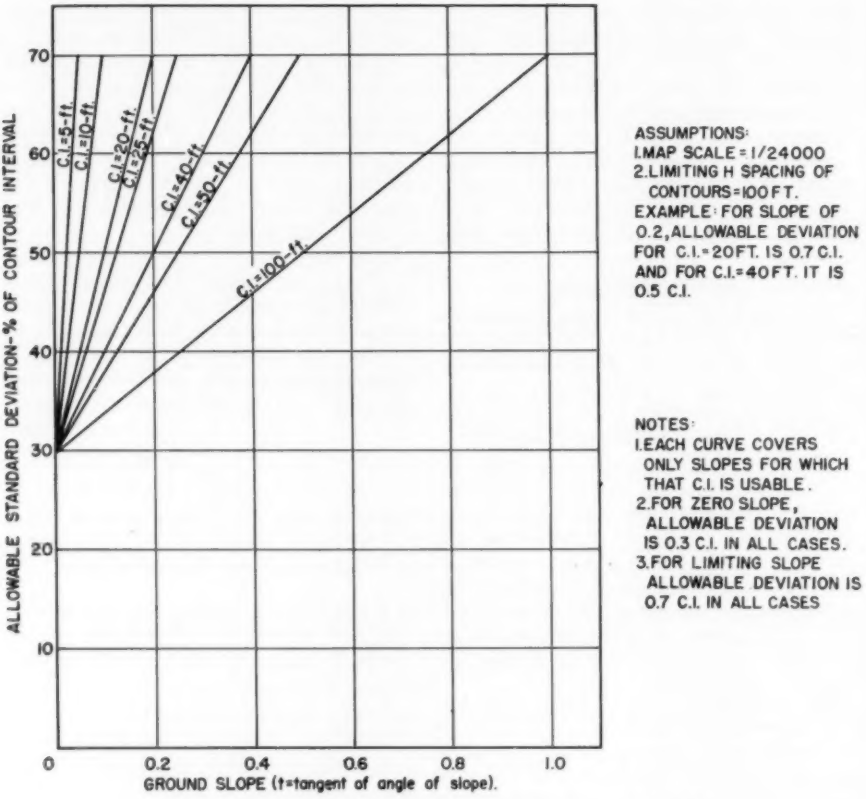


FIGURE 4.—Vertical tolerances in percent of contour interval.

British Standards

According to a recently issued British Ordnance Survey Paper, "The Indication of Relief," the British seem to have adopted a standard contour interval of 25 feet for maps on the two standard mapping scales, 1:25,000 and 6 inches = 1 mile (or 1:10,560). The vertical tolerance (in terms of standard deviation, d, and ground slope, t) is stated as follows:

For 1:25,000 maps,

$$d = \pm 6\sqrt{1 + 17t^2}. \quad (6)$$

For 6-inches-to-the-mile maps,

$$d = \pm 6\sqrt{1 + 3t^2}. \quad (7)$$

These tolerances are represented in figure 5, along with comparable American and German tolerances. The British 1:25,000 maps with a 25-foot interval are approximately comparable to the common American 1:24,000 maps with a 20-foot interval. The limiting slope for the British 1:25,000 maps is taken as 0.25, in accordance with table 3. Figure 5 shows that, for zero ground slope, the vertical tolerance, in terms of standard deviation, is 6 feet, in either the British or American standard. As the slope increases, however, the American practical standard shows an increasing amount of tolerance as compared to the British. The theoretical American tolerance, however, rather closely approaches the British tolerance.

In addition to the specifications for the

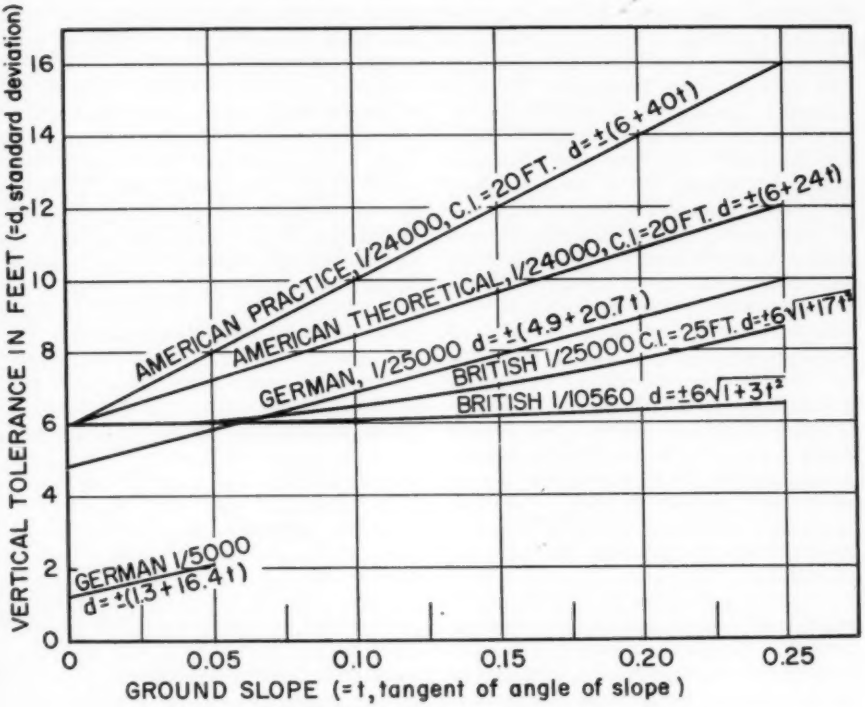


FIGURE 5.—British, German, and American vertical tolerances.

vertical accuracy of points, the British standard further specifies that the standard deviation of contour interval shall be ± 4.5 feet (except that in steep areas it is increased to 6 feet).

This means that the British not only test the absolute error of each contour, but also the relative error of one contour with respect to the next.

German standards

According to Schwidefsky[2], the German topographic base map, at a scale of 1:5,000, allows a vertical tolerance in accordance with the equation:

$d = \pm\ (0.4 + 5t)$, expressed in meters.

In feet this would be:

$$d = \pm\ (1.3 + 16.4t). \qquad (8)$$

[2] Grundriss der Photogrammetrie, K. Schwidefsky, *Verlag für Wissenschaft und Fachbuch G. M. B. H.*, Bielfeld, 1950.

Official German specifications are not given for 1:25,000 maps, but Schwidefsky presents, as a practical tolerance based on attainable results with photogrammetric methods, the following equation:

$d = \pm\ (1.50 + 6.3t)$, expressed in meters.

In feet this would be:

$$d = \pm\ (4.9 + 20.7t). \qquad (9)$$

This equation is similar in form to the equation for American practical tolerance, and almost identical with the equation for American theoretical tolerance.

By reference to figure 5, we can see that, although the British, German and American tolerances differ in value, a similar trend is observable in all.

CONCLUSIONS

Although one sometimes hears the criticism that American map-accuracy specifications are too tight, it is readily apparent that they are not nearly as tight as British

or German standards. If we relax our standards in order to obtain a higher rate of production, we will doubtless soon find that the maps are inadequate for some purposes. On the other hand, if we go in the other direction and attempt to bring our standards into line with European standards, there will be an inevitable sharp increase in costs and a reduction in the rate of production. The question is: Do our present standards meet the needs? On the whole, the answer is yes. Our problem is extensive, whereas the European problem is intensive. Although our accuracy standards are not as high as European standards, they are still sufficiently high for our needs and have a general trend similar to that of the European standards. The present situation indicates that we should occupy a middle position between the opposing requirements of high accuracy and high production. That is approximately the position we occupy with our present standards.

It is highly desirable that a full understanding of the real meaning of American vertical accuracy standards become widespread. The notion that the first part of the specification is the whole specification should be corrected wherever it exists. The effect of the horizontal shift should be axiomatic knowledge to all who are concerned with map accuracy.

Finally, we need to examine the language of the present accuracy specification to see whether it needs to be made more up-to-date, more scientific, or more in line with universal practice. Should we express allowable tolerance in terms of standard deviation? Should we eliminate the horizontal shift and express the total tolerance by an expression such as equation 3 (that is, $d = \pm [0.3\ C.\ I. + bt]$)? These are questions that need careful study, for the advantages of changing the specifications are accompanied by disadvantages. There is a natural reluctance to change from a system which has essentially served the purpose for a number of years and with which we are all familiar. There is also a possibility of difficulty in interpreting the tolerance equation, especially in determining the value of the ground slope. A change in specification such as might be suggested by the content of this paper is not to be lightly undertaken. We need to consider and discuss the pros and cons of the argument thoroughly. Then, if qualified opinion is preponderantly in favor of a change, appropriate action should be taken.

❦ ❦ ❦

"2020 Review Questions for Surveyors"

THIS is the third edition of a mimeographed book of questions on surveying by Prof. R. C. Brinker, Virginia Polytechnic Institute. The first edition containing 1313 questions was reported on page 172 of the April-June 1951 issue of SURVEYING AND MAPPING.

In this edition, as in the preceding editions, the questions are arranged under 25 subjects; answers are included to 1140 questions. There are three general types of questions: multiple choice, completion and problem, and true or false.

The new edition includes problems from a dozen colleges, questions from the registration or Civil Service examinations in 14 states, and a list of suggested abbreviations and "hand signals" for use in surveying.

Professor Brinker expects this to be the last edition, but we expect that the gratifying acceptance of the first two editions will be extended to this one and so on into the future.

The book provides teachers with new material for their examinations, and provides students with a valuable supplement to their other text books, especially when used to review for examinations.

The book contains 152 pages and is purchasable at $3.00 a copy, or $2.50 each in orders of five or more, from Prof. R. C. Brinker, Box 153, Blacksburg, Va.

—K. T. ADAMS

Geodetic Operations in Mexico

By MANUEL MEDINA
CHAIRMAN, COMMITTEE OF GEODESY
PAN AMERICAN INSTITUTE OF GEOGRAPHY AND HISTORY

I AM GOING to relate briefly some interesting aspects of geodesy in Mexico—not only the scientific operations themselves, but also some characteristics that are peculiar to my country. A few years ago I had the opportunity to see a motion picture about triangulation as executed by engineers of the Coast and Geodetic Survey. I recall the sequence of operations: First, a truck transporting two men arrived on a nice level field. They got out, took out their instruments—one prismatic compass and other gear—and rapidly made some observations. "This is all right," one of them said; "go and call the owner of this property." Some minutes later the rancher arrived, scratching one of his ears. They explained the purpose of their work to him in a few words. "All right," the landowner said, and the first two men rapidly took from a bag some construction material, then some tools, and in a few minutes the station was established.

The second part of the motion picture was more interesting. It showed perfect organization in all respects: the erection of the steel tower, the hoisting of the instruments with power from the truck engine, the centering of the theodolite, and the observations made by three men. Later, after the night's work was finished, they rested in a comfortable little camp in trailers and tents with their families who had hot coffee ready for them and then they slept in beds between cool sheets.

This picture recalled to me one of the many adventures I had had during my life as a geodesist; but I will tell you about it a little later.

First, I would like to relate something about the history and accomplishments of my organization. Geodetic operations in Mexico can be said to have been begun about 52 years ago. The first arc of triangulation established in Mexico was along the 98th meridian, and it was the same meridian that the Coast and Geodetic Survey chose for one of its north-south arcs. Thus we collaborated in the measurement of one of the longest arcs of triangulation in the world.

This operation of the highest order of accuracy was, at the same time, the practical training ground for Mexican geodesists, of whom there are only three or four still alive. Included among them is Dr. Pedro C. Sánchez, former Director of my office and First Director of the Pan American Institute of Geography and History. The culmination of this work was the connection between the Mexican and U. S. triangulation systems in 1916, in which operation I had the opportunity to serve as assistant to the Chief Engineer.

This connection was indeed very important for us. It afforded us the means for computing the geodetic coordinates of our stations on the North American datum, and it also gave us a check on our operations.

Since the completion of this arc of triangulation, all subsequent arcs measured in Mexico have had an immediate application to cartographic needs. Forty or fifty years ago, we had no maps or charts, and some parts of our land were unexplored. In some of my expeditions through the jungles of the States of Chiapas and Yucatán I had the impression that I was the first civilized visitor to pass through these regions.

Since it was necessary to map these areas without delay, astronomical fixes were frequently used as control instead of triangulation. But in other areas, as in Yucatán, it was possible to extend arcs of triangulation by using high wooden towers, with ties to a first-order astronomical station.

Presented at the Twelfth Annual Meeting, American Congress on Surveying and Mapping, June 11–13, 1952, Washington, D. C.

An old colonial church in Yucatán, Mexico, used as a triangulation tower.

Many times we had to use monuments of the old Mayan civilization as geodetic stations, as you can see in the accompanying photographs. One photograph shows an old colonial church, one of whose towers was used as the support for the theodolite, surrounded by a special framework for the observer. The other shows a wooden triangulation tower erected on top of the well-known pyramid of Chichén-Itzá.

All these observations in Yucatán were made at night and acetylene signal lamps were used for the first time. But in other areas, as in Tabasco and part of Chiapas, there are such great marshes that ordinary triangulation is not economical and we are hoping to use electronic methods here for control.

Thus, with the combined help of triangulation and astronomy, and utilizing a large number of land surveys, it was possible to complete the first set of maps of all the States of Mexico in a few years. This important work was carried out by the Dirección de Estudios Geográficos y Climatológicos, successor to the Comisión Geodésica Mexicana.

We have always had in mind the need of extending triangulation arcs all over the country, to serve as control for complete and accurate cartography. After 50 years of operations we have completed arcs of first-order triangulation extending about 9,000 kilometers and covering 318,000 square kilometers, in which are about 500 geodetic stations.

Geodesy is usually considered to include such operations as precise leveling, geodetic astronomy, and gravimetry. All these have been performed in Mexico in some degree.

The lines of precise leveling in Mexico now total some 1,500 kilometers. Leveling operations have been increased recently in order to connect in elevation all the tide gages established along the Gulf of Mexico and the Pacific Coast; and between these coasts we must also have precise leveling. A line of precise levels is now being run between Coatzacoalcos on the Gulf of Mexico and Salina Cruz on the Pacific Ocean—300 kilometers apart. We think this is a very good place to run precise levels

The pyramid of Chichén-Itzá, Yucatán, Mexico, one of the most famous Mayan ruins, on whose top a triangulation tower was erected.

between two significant points on the geoid, because of the short distance between the two coasts. Furthermore, we are anxious to see whether, after all orthometric and gravimetric corrections have been made, the apparent difference of elevation between both oceans exceeds about 7 centimeters, which we estimate to be the probable error of the observations.

By means of precise levels repeated periodically across the City of Mexico, we have been able to determine and measure the gradual subsidence of the ground here. This subsidence is now proceeding at an accelerated rate.

As you know, the City of Mexico was built on land where the subsoil was permanently saturated with water. As the subsoil dries, the land sinks. In some places, this subsidence amounts to about 50 centimeters per year. This creates a terrific problem for both builders and inhabitants. And geodesists have the interesting problem of running levels over ground that is constantly changing in elevation. It is not possible to check the results as is usually done, unless all the observations were made simultaneously by many observers, which is impossible.

Mexican and U. S. geodesists around the theodolite used in the observations at station FEELY, Texas, another point in the connection.

Group of Mexican and U. S. geodesists at one of the Mexican points selected for the connection between the triangulation networks of both countries.

With regard to geodetic astronomy, we have some Laplace stations, through which the deflection of the vertical has been determined. The maximum value of the deflection encountered in Mexico is 15 seconds of arc. Besides the Laplace stations, we have several hundred astronomical stations, established as control for mapping. Gravimetry in Mexico had its start in 1912, when one of our observers came to Washington and made a comparison between the base gravity station at the Coast and Geodetic Survey and our own base. Since then about 100 pendulum gravity stations have been observed in Mexico.

Some of our triangulation arcs have been connected across the U. S.–Mexico boundary with the triangulation of the Coast and Geodetic Survey. In 1951 we made a connection along the 101st meridian. We had the pleasure of receiving the U. S. geodesists at the Mexican stations and of observing and computing the observations in great harmony. The results of the last tie were highly satisfactory, even though it was distant from the measured bases on both sides.

On our southern boundary we have al-

ready made the connection with the triangulation system of Guatemala, but in order to have a continuous arc between North and Central America, we are working at present on a triangulation tie between the terminus of the 98th meridian arc and the Guatemala triangulation across the States of Oaxaca and Chiapas. Here we have to bridge a gap of 150 kilometers with 11 geodetic stations. This triangulation is very difficult, and it brings to mind the adventure I mentioned earlier. I said difficult triangulation, but I should have said terrible triangulation. Nevertheless, the conditions are very different because in Chiapas we are fighting nature, whereas sometimes in the past we have had to fight men.

Once we had to observe at a station in the State of Aguascalientes during one of our revolutions. The ascent of the mountain, with the equipment, food, and tents carried on the backs of mules, was very difficult and exhausting. It took us about 8 hours to reach the top. When all the instruments were in place and we were ready to begin observing, I was called insistently by Morse code from another station. I was irritated by the interruption but, on acknowledging the call, I received the following message: "Take care. A party of revolutionists has been reported marching toward your camp." "O. K.," I answered, but I felt my blood freezing.

As all the signal lamps were showing well, I began the observations, with my eye at the theodolite but my ear attuned to the noises of the forest. In each rustle of the trees, I seemed to hear the footsteps of the rebels. The only weapon that I had was a little Winchester .22. In 5 or 6 hours all the observations were finished, and I went to my camp bed and lay down with my gun near my hand. I was so tired that I slept like a log. When I woke up, the sun was shining on the roof of my tent, and my first act was to draw a deep breath of satisfaction and relief. As all the observations were satisfactory, we left immediately. We made our way down the mountain much faster than we had ascended it, as you can well imagine!

New Gurley Ephemeris and Almanac

The 1953 edition of the Gurley Ephemeris—including an almanac listing 28 selected stars for determining azimuth by stellar observations—is now available from W. & L. E. Gurley, Troy, N. Y., 108-year-old manufacturer of engineering and surveying instruments.

A similar almanac appeared, for the first time, as a supplement to Gurley's 1952 edition. Its wide use among surveyors and engineers caused Gurley to incorporate a similar section into the 1953 Ephemeris itself.

The almanac section of the 100-page, pocket-size booklet is an abridgement of the American Nautical Almanac, and gives complete instruction for determining azimuths by methods similar to those used in observations of the sun and Polaris. This advance in methods of meridian determination is the work of Dan Harkness, former Assistant Professor of Civil Engineering at the University of Nebraska and now a member of the Gurley staff. The 28 stars were selected by cadastral engineers of the Bureau of Land Management, U. S. Dept. of Interior.

The Ephemeris includes definitions of astronomical terms, descriptions of methods of observation, and examples of reducing data for determining a true meridian.

Also included are astronomic and trigonometric tables abridged from the American Ephemeris and Nautical Almanac and the Standard Field Tables, Bureau of Land Management.

The Ephemeris will be sent free, upon request, to practicing surveyors and engineers and to instructors and students of surveying engaged in making observations requiring its use.

Adverse Possession as Defined by Washington State Court Decisions

By JAMES H. McLERRAN
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THE object of this paper is to dispel some of the confusion that surrounds the subject of adverse possession. Few surveyors, or engineers acting as land surveyors, have sufficient knowledge of how the courts have defined the essentials of adverse possession. Although it is not difficult to find the general statutes, or decisions, that declare the necessary elements to establish adverse possession, it is difficult to find and understand the interpretations of what is necessary to prove that these elements are well met.

It is not suggested that any surveyor should attempt to do more than advise his client, or other interested parties, of the facts that may or may not be present to establish adverse title. Contrary to several opinions that the surveyor should not advise upon adverse possession, it is found that the surveyor is often called on to advise clients, and also their attorneys. He is also frequently called as a court witness in such actions as accrue, that he has come in contact with.

It should be noted here that adverse possession under color of title is not considered in this paper.

One should apply the facts and results of one case of adverse possession with extreme caution to another case. It is better to develop a knowledge of the general intent, rather than the specific details, and relate the general intent of a decision to a specific case, viz:

> A reading of the cases, of course, discloses that no two cases are alike in their facts and each case must stand on its own bottom.[1]

GENERAL

Adverse possession has the legal effect of transfer of the legal title to land from one owner to another person, without the consent of the first owner. Rem. Rev. Stat. Sec. 156 prescribes that action for the recovery of real property must be commenced within 10 years. The Supreme Court of the State of Washington has declared that to establish adverse possession the following must be present: actual and uninterrupted, open and notorious, and hostile and exclusive possession under the claim of right made in good faith. To constitute title, these elements must have been continuously present for the entire period.

In the words of the court:

> In order to establish title by adverse possession, one must clearly demonstrate the hostile character of the possession. the presumption being that one who enters the property of another does so in subordination to the title of the real owner. Possession, to be adverse, must be actual and uninterrupted, open and notorious, hostile and exclusive, and under a claim of right made in good faith; and to constitute title, it must have continued for the entire statutory period, which in this state is ten years. While the word "hostile," where used as an element of adverse possession, does not necessarily import enmity or ill will, it does import that the claimant is in possession as owner, in contradiction to holding in recognition of, or subordinate to, the true owner.[2]

ELEMENTS

Actual and Uninterrupted Possession.—It is essential that the adverse holder, or a party such as a tenant or a contract purchaser holding possession under him, be in

[1] *Mittet* v. *Hansen,* 178 Wash. 541; *Kent* v. *Holderman,* 140 Wash. 353.

[2] *Aller* v. *Nebecker and Peck,* Supr. Yakima County. *See also, Roesch* v. *Gerst,* 18 Wash. (2) 294; *King* v. *Bassindale,* 127 Wash. 189; *Pacific Power & Light Co.* v. *Bailey,* 160 Wash. 663; *Mittet* v. *Hansen,* 178 Wash. 541; *Skoog* v. *Seymour,* 29 Wash. (2d) 355; *Young* v. *Newbro,* 32 Wash. (2d) 141.

actual possession.

Possession is always actual when it is an open and visible occupation. Residence is an effective mode of establishing actual possession, but in matters of boundary the making of improvements to the line claimed is of greater significance because it informs the owner of occupancy of the disputed land. This must be a permanent intrusion and not merely a temporary trespass.

The State Supreme Court held, in *Erickson* v. *Murlin*,[3] that land under the overhanging eaves of a garage was acquired by adverse possession. The building of a fence for pasturage does not constitute such possession as would establish adverse title; however, such an act would not hold against a claim of adverse possession if the use of the land were an incident under a claim of right.[4] Such things as entry upon an unoccupied and unimproved tract for the purpose of cutting firewood;[5] the filing of a plat;[6] the piling of wood, mowing of hay, and planting grass[7] have been held as insufficient possession to be adverse.

Possession to be adverse must have continued uninterrupted for the entire statutory period, which in this state is 10 years. It is not essential that the adverse possession be held against the same party throughout the required period, and neither is it essential that the same party hold it for the entire period.

If the adverse holder sells his land and the bona fide purchaser goes into immediate possession, then the adverse holding is not interrupted and the new owner is allowed to take the time of the first owner's adverse possession. Also a landlord may tack a tenant's possession to his own.[8]

The holding is considered interrupted, though, if the adverse holder accepts a lease on the land from the title holder.[9]

[3] *Erickson* v. *Murlin*, 39 Wash. 43.
[4] *Young* v. *Newbro*, 32 Wash. (2d) 141.
[5] *Pettigrew* v. *Greenshields*, 61 Wash. 614.
[6] *Ferry* v. *Hobson*, 22 Wash. (2d) 613.
[7] *Smith* v. *Chambers*, 112 Wash. 600.
[8] *McAuliff* v. *Parker*, 10 Wash. 141.
[9] *Northern Pacific Ry. Co.* v. *George*, 51 Wash. 303.

It is not essential that the adverse holder keep his flag flying forever. An interruption after the possession has been established over a sufficient time to cover the statute of limitations does not affect the title acquired.

The Court in the case of *Mugaas* v. *Smith*[10] said:

> The fact that the respondent had ceased to use the strip in question in such a way that her claim of adverse possession was apparent, did not divest her of the title she had acquired.
>
> We have on several occasions approved a statement which appears in *Towles* v. *Hamilton*, 94 Neb. 588, 143 N.W. 935, that:
>
> "It is elementary that where the title has become fully vested by disseizin so long continued as to bar an action, it cannot be divested by parol abandonment or relinquishment or by verbal declarations of the disseizor, nor by any other act short of what would be required in a case where his title was by deed."

Open and Notorious.—To secure title by claim of adverse possession, the possession of disseizor must be open and notorious, or the owner must have had actual notice of the possession. An oral notice of possession is not required; however, against a nonresident owner, "Title is not acquired to land in a remote mountainous country" without actual notice.[11]

The opinion of the court as to why an oral notice is not required is illustrated by the following quotation from the case of *Nixon* v. *Merchant*:[12]

> The Supreme Court of Montana said, in the case *Rude* v. *Marshall*, 54 Mont. 27, 166 Pac. 298:
>
> "If it was the intention to announce the doctrine that one who claims to hold adversely must make his intention manifest by word of mouth, proclaiming from the housetops his purpose, then we must respectfully decline to follow or approve a rule directly opposed to reason and the authorities generally. It is an old adage 'Actions speak louder than words,' and the truth of the maxim is nowhere made more apparent than in cases involving the

[10] *Mugaas* v. *Smith*, 33 Wash. (2d) 429. *See also, McKinnis* v. *Day Lbr. Co.* 102 Wash. 38; *King County* v. *Hagen*, 30 Wash. (2d) 847.
[11] *Murray* v. *Bousquet*, 154 Wash. 42.
[12] *Nixon* v. *Merchant*, 19 Wash. (2d) 97.

claim of adverse possession of real property."

What constitutes open and notorious possession depends on the facts of each case. In *Aller* v. *Nebecker and Peck,* the Superior Court in Yakima observed:[13]

That open and notorious possession, as applied to adverse possession, means that the disseizor's claim of ownership must be evidenced by acts and conduct sufficient to put a man of ordinary prudence on notice of the fact that the land in question is held by the claimant as his own; and it will be presumed that the owner knew of a possession which was openly, notoriously, and visibly maintained for the statutory period.

Fencing of lands (under a claim of ownership, but not for convenience), cultivation, erection of buildings, building and maintaining a cistern, planting and care of fruit trees, and the harvesting of crops on disputed land have been held to be such acts as would be open and notorious.

Exclusive.—Briefly, it is essential that the possession be exclusive. The necessity of this is apparent when one of the parties in possession is the rightful owner, as there can be no disseizin unless the rightful owner is altogether deprived of his possession.

Hostile.—Possession to be adverse must be hostile. The Supreme Court of the State of Washington has said that:

The term "Hostile" as so used does not import enmity or ill will, but rather imports that the claimant is in possession as owner, in contradistinction to holding in recognition of, or subordination to the true owner. [14]

To be hostile there must be no permissive holding. Where a party takes possession of property with the permission of its real owner, knowing at the time that he was the real owner, the presumption is that the possession of this party is not adverse.

Building a fence upon a line does not in itself constitute adverse possession. There must be evidence of a hostile intent of a claim of ownership.

Title by adverse possession is not acquired by the permissive building of a fence in an irregular line part of the way, approximately along the supposed boundary line, where the parties at all times contemplated a survey to determine the true line, and neither party claimed to the fence or made any permanent improvements.[15]

Where the use is permissive in its inception, then such permissive character, being stamped on the use at the outset, will continue of the same nature and no adverse user can arise until a distinct and positive assertion of a right hostile to the owner, and brought home to him, can transform a subordinate and friendly holding into one of an opposite nature, and exclusive and independent in its character.[16]

It is established that where one of two adjacent landowners extends his fence onto his neighbor's land, without knowledge of the location of the true line, and without intention of claiming other than to his true boundary line, his possession is not hostile and, therefore, is not adverse.[17]

Claim of Right Made in Good Faith.—This requirement means that the adverse holder must have a bona fide belief that he is the true owner of the disputed land. In the case of *Aller* v. *Nebecker and Peck,*[18] the Court observed:

That merely claiming land to a boundary, believing it to be the true line, is not sufficient to constitute a basis for a claim by adverse possession, since the claim of right must be as broad as the possession.

And in *Young* v. *Newbro,*[19] the Court observed:

The mere possession of land beyond the real boundary line is not sufficient to make such a holding adverse, but there must be, in addition, an intention to claim title and to hold it as the owner.

And further stated:

The mere building of a fence for pasturage on disputed land does not constitute such possession as would establish an adverse title; how-

[13] *Aller* v. *Nebecker and Peck,* Supr. Yakima County.

[14] *King* v. *Bassindale,* 127 Wash. 189.

[15] *Lindberg* v. *Davis,* 164, Wash. 680.

[16] *Scheller* v. *Pierce County,* 55 Wash. 298.

[17] *See* Note 97 A.L.R. 21, pages 27 & 32.

[18] *Aller* v. *Nebecker and Peck,* Supr. Yakima County. *See* Note, 97 A.L.R. 35; *Wilcox* v. *Smith,* 38 Wash. 585; *Skanski* v. *Novak,* 84 Wash. 39.

[19] *Young* v. *Newbro,* 32 Wash. (2d) 141.

ever, such act would not militate against a claim of adverse holding if the use of the land were an incident under a claim of right, the question being whether a property fence is maintained as a matter of convenience or under a claim of ownership.

In the case of *King* v. *Bassindale,*[20] the Court held:

Title by adverse possession up to a boundary line fence is acquired by one who purchases a lot in the belief that the fence marked the true boundary line, and maintained, for the statutory period, exclusive, open and notorious possession under a *claim of right.*

INTENT

It may be seen from the discussion of the hostile element that intention is a controlling factor.

Adverse possession is founded upon the intent with which the occupant has held possession, *and this intent is to be determined by what he has done.*[21]

BURDEN OF PROOF

The burden of proof is the obligation of those who seek to establish title by adverse possession.[22]

STATUTE OF LIMITATION

Code of 1881, Sec. 26 (1); Rem. Rev. Stat. Sec. 156, State of Washington reads:

The period prescribed in the preceding section for the commencement of actions shall be as follows:

Within ten years:

1. Action for the recovery of real property, or for the recovery of the possession thereof; and no action shall be maintained for such recovery unless it appear that the plaintiff, his ancestor, predecessor, or grantor, was seised or possessed of the premises in question within ten years before the commencement of the action.

[20] *King* v. *Bassindale,* 127 Wash. 189.

[21] *Aller* v. *Nebecker and Peck,* Supr. Yakima County.

[22] *Bowden-Gazzam Co.* v. *Kent,* 22 Wash. (2d) 41.

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POCKET-SIZE COMPUTING MACHINE

Field parties required to make frequent on-the-spot computation of a high degree of precision will be immeasurably aided by a new pocket-size computing machine of the single-step drum type.

The 8-ounce machine, which is called "Curta," can multiply an 8-digit number by a 6-digit number and give an 11-digit answer. Operating like a standard manual office machine, it can add, subtract, multiply, and divide. Additional information about the instrument, which is manufactured in Lichtenstein, Europe, can be obtained from Serge A. Emery, 41 Shonnard Ave., Freeport, N. Y.—*Civil Engineering,* December 1952.

Kissimmee Valley Mapping Project

(*A Symposium*)

The three articles which follow appeared originally in the Proceedings of the Third Annual Surveying and Mapping Conference, held on November 15 and 16, 1950, on the campus of the University of Florida. These conferences are sponsored by the Civil Engineering Department of the College of Engineering as a function of the Engineering and Industrial Experiment Station, University of Florida.

The three articles together give the complete story of how an unusual mapping undertaking was carried out. —EDITOR

Mapping of the Kissimmee Valley

By GEORGE D. HARDY

CORPS OF ENGINEERS, U. S. ARMY, JACKSONVILLE, FLA.

THIS PAPER gives some of the background of the Kissimmee Mapping Project, explains why the specifications were written as they were, and gives some idea of mapping costs for this type of work. The technical phases of the mapping are covered in the two following papers.

When the Definite Project Report on the Central and Southern Florida Flood Control Plan was written, it was obvious that, to control the waters of Lake Okeechobee and of the area south of Lake Okeechobee, it would be absolutely necessary to control also the Kissimmee River and other feeder streams to the north of Lake Okeechobee. When the Corps of Engineers first started its investigation of the Kissimmee Valley it immediately became aware of the lack of topographic data throughout the valley—in fact not even the exact drainage area of the Kissimmee River was known. To control the water of the valley and to prevent intermittent floods and droughts, it was necessary to obtain complete topographic maps of the area. Ways and means of obtaining this information were discussed by the Design Engineers, the Chief of the Engineering Division, and representatives of the Survey Branch.

The design men stated that they needed topographic maps with contours at 1-foot intervals throughout the valley, and the Survey Branch was asked to prepare a cost estimate for accomplishing this work.

To obtain 1-foot contours over approximately 4,400 square miles by standard methods is an enormous undertaking and the first estimate of the cost ran in the neighborhood of $2,500,000. Of course this seemed like an exorbitant figure for mapping, although it compared favorably with standard mapping costs throughout the United States. We did not, however, have funds available to accomplish the work, so after further discussion it was decided that the largest possible contour interval that could be used would be 5 feet. In the flat river valley, however, a difference of 5 feet in elevation would displace the contour possibly 5 to 8 miles and this did not seem to meet the needs in connection with design. After considerable discussion it was decided that we would call in 5 or 6 of the larger mapping contractors in the country, let them look the job over and make suggestions. This was done.

The writer, personally, led the representatives of several organizations over the area and was greatly surprised at the different methods each thought he would use in mapping this area. However, they all agreed that to accomplish the ends we desired it would be necessary that we have contours to an accuracy of plus or minus 0.75 foot in the flat river valley.

Through the efforts of the Chief of the Engineering Division, Leo L. Burnett, and our District Engineer, Col. Richard W.

Pearson, we were able to obtain a small allotment of funds from the Office of Chief of Engineers with which to start the work on a continuing contract basis.

With the knowledge of the contractors' ideas and our own knowledge of the valley we decided that we would write specifications to do this mapping on a 5-foot interval basis. It was decided to call for a lump sum bid on the project and to write our specifications so that we would obtain a final product that would meet our needs, without specifying the method to be used by the contractor in accomplishing the work. It was believed that by not limiting the contractor to a specific method we would get a much lower bid.

The specifications as issued called for furnishing the following:

Controlled aerial mosaics for sixty-seven 7½-minute quadrangles at a scale of 1:24,000 with one photographic negative and one contact print of each of these mosaics before contours were placed on them.

A photographic negative and two contact prints each of fifty of the controlled mosaics after 5-foot contours were added.

All items used in the preparation of the contoured and uncontoured mosaics, such as original negatives of all aerial photography, one set of contact prints of all aerial photographs, negatives of photo indexes of all photography at a scale of approximately 1 inch = 1 mile on 18- by 24-inch sheets.

One set of prints of aerial photographs with all horizontal and vertical control and land corners recovered or set, pricked and marked thereon.

Complete data for control points established or recovered, including descriptions of permanent stations.

Complete field notes and computations covering all horizontal and vertical control established.

All planetable sheets, compilations, photographs, copy negatives, and other material used in compiling information incorporated into the mosaics.

Controlled mosaics to be laid on ¼-inch tempered masonite and at the scale of 1 : 24,000, regardless of photographic scale.

All mosaics to be marked with geographic coordinates and plane rectangular coordinate lines based on standard Plane Rectangular Coordinate System for the East Zone of Florida.

Marginal data, similar to that placed on standard U. S. Geological Survey quadrangle sheets, placed on each quadrangle map.

Mosaics to have names of all rivers, streams, lakes, towns, railroad stations, railroads, canals, airports, and other cultural features of prominence shown thereon.

All horizontal and vertical control stations to be indicated by proper symbol and designation.

All section and quarter-section corners found during the progress of the work to be identified on the contact prints and shown by proper symbol on the mosaics.

State and Federal highway numbers shown by the proper symbol on the 50 quadrangles which are to be contoured.

Contours shown on 5-foot intervals, and sufficient number of spot elevations shown to define the topography clearly.

It was necessary to restrict the compilation method somewhat, so that one of the products would be planetable sheets of the flat river valley that could later be used to arrive at exact pooling heights and to show what areas would be covered by water at these heights. To do this the following items were inserted in the specifications:

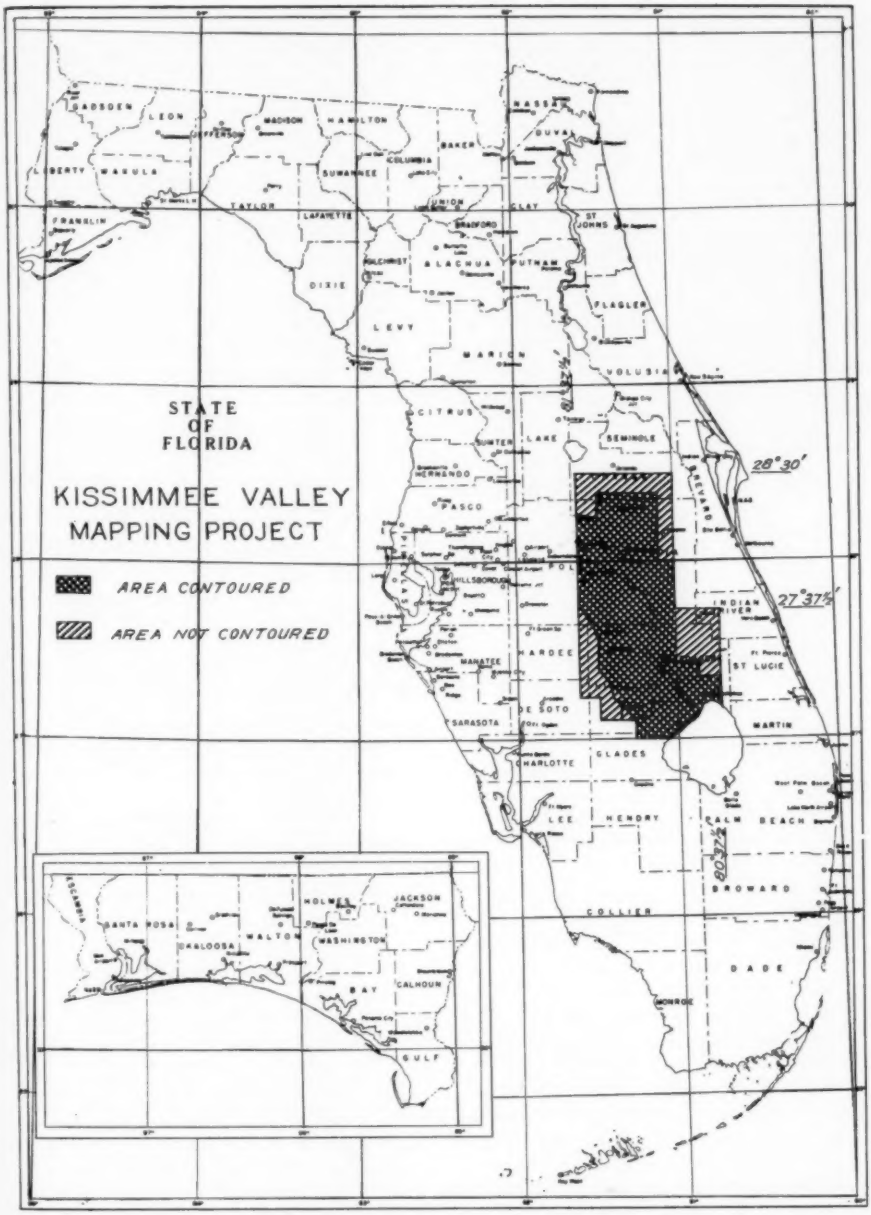
Planetable topography is to be run on mounted 1 : 18,000 scale photographic reproductions of the uncontoured mosaics.

Spot elevations, on approximately 1,000-foot grid, and sufficient additional elevations to define the topography clearly, as well as the contours, are to be plotted on the planetable sheet in the field.

In area to be contoured by photogrammetric methods, aerial photographs at a scale of not smaller than 1 : 12,500 are to be flown in a north-south direction; contours and sufficient spot elevations to define topography clearly are to be run with a photogrammetric plotter of a type approved by contracting officer.

Specifications for the control to be established stated that all horizontal control and all level lines should be of third-order accuracy or better. Location of certain specific bench marks was designated and the contractor was required to place a pair of horizontal stations at approximately 3-mile intervals on each of the horizontal lines run.

The map accuracy requirements were as follows:



MAP OF FLORIDA SHOWING LOCATION OF THE PROJECT

Mosaic shall meet standard map accuracy requirements which state "that at least 90 percent of all points or positions shown on the mosaic shall be accurate to within 0.02 inch of their true geographic position and no point shall be greater than 0.05 inch from its true position." This means that 90 percent of all points shown on the controlled mosaics shall be within 40 feet of their true positions, and no point shall be more than 100 feet from its true position. The vertical accuracy requirements shall be those required for standard map accuracy or better.

In any area where the majority of the 5-foot contours are less than 1,320 feet apart horizontally, 90 percent of all points interpolated from the contours shall be within one-half of the contour interval, and no point interpolated from the contour shall be in error more than the contour interval.

In any area where the majority of the contours are more than 1,320 feet apart horizontally, 90 percent of all points interpolated from the contours shall be within 0.75 foot of the true elevation, and no point interpolated shall be in error more than 1.5 feet .

Elevations of all monumented control points shall be established by leveling, using third-order methods, and all level lines shall close within the accuracy prescribed by the U. S. Coast and Geodetic Survey for third-order levels.

The value of all spot heights within the areas where the majority of the contours are less than 1,320 feet apart shall be accurate within one quarter of the contour interval.

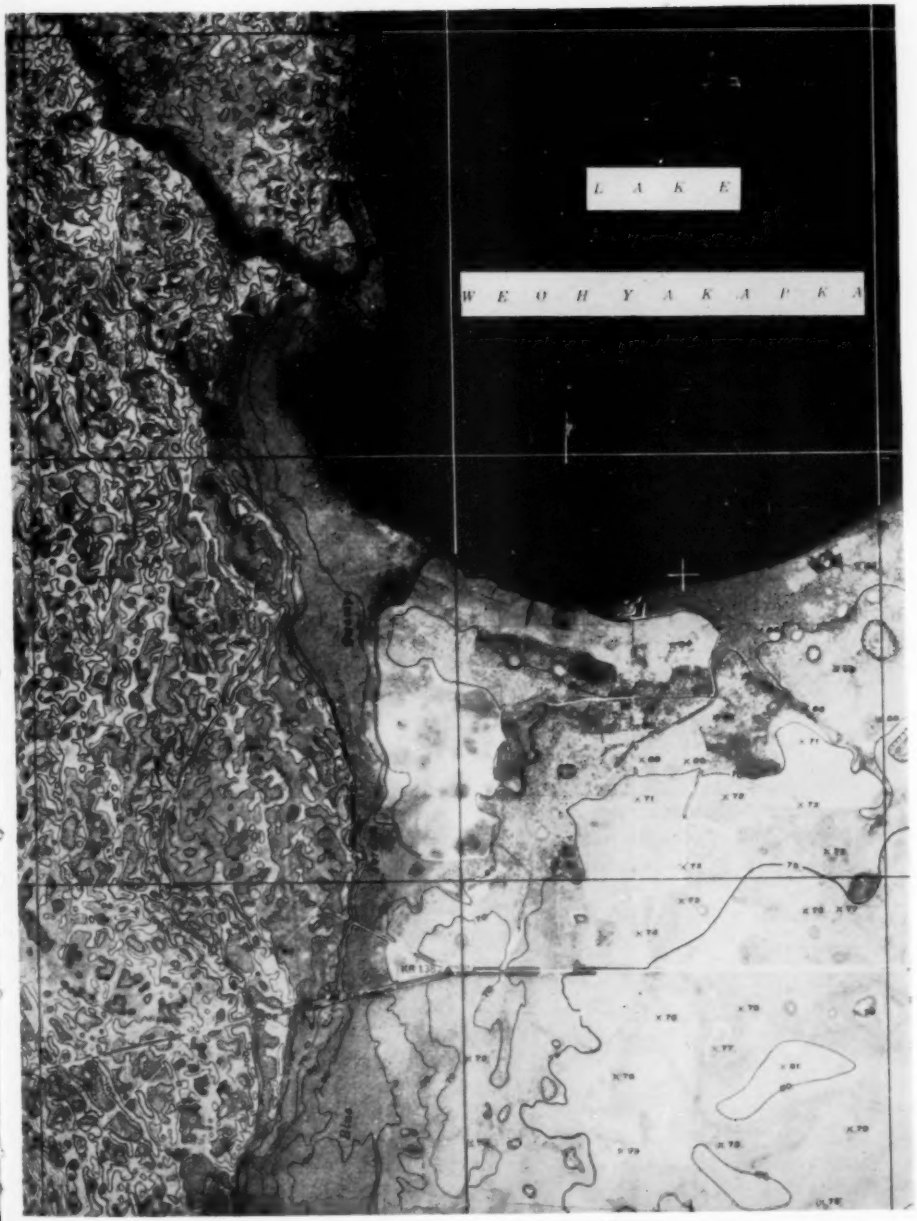
The value of all spot heights in the area where the majority of contours are greater than 1,320 feet apart shall be within 0.75 foot of their true elevation.

In addition to meeting the above requirements, the specifications required the contractor to furnish a detailed statement of the methods and procedures he intended to use in connection with the mapping. The different requirements of these specifications were made in order to use the controlled mosaic method, instead of standard line drawings, because there is so much more information shown on a mosaic, especially as to ground coverage, pasture land, agricultural development, etc. We required standard map accuracy for these mosaics so that they could be furnished to the U. S. Geological Survey at a later date for use in making standard topographic maps. Therefore, we held our specifications to those required by the U. S. Geological Survey, and tried to make our quadrangle sheets as nearly like theirs as possible. This mapping project is probably the only one of its type ever accomplished in the United States. It is probably also one of the largest individual contracts for topographic mapping ever let by the United States Government.

After the specifications were written and invitations to bid issued, it became necessary to make a detailed Government estimate to submit so that we would have a comparison between what the Government thought the cost should be and the contractors' bids. The final estimate for the complete project was $275,000.

There were five bidders. When the bids were opened, the low bidder was Michael Baker, Jr., Inc., with a bid of $276,000, the second low bidder was Aero Service Corporation, with a bid of $276,900; and other bids varied from $300,000 to something over $500,000. The extreme spread between the government estimate and the two lowest bids was only $1,900, which is exceedingly close considering the different methods each of us proposed to use. The per acre cost of this project is about 17 cents, which compares extremely favorably with the general cost of topographic mapping. A news item recently stated that the average cost of topographic mapping in the United States was 25 cents per acre and such an average is probably based on mapping at 10- and 20-foot contour intervals.

Fulfillment of the requirements specified in the invitation has required considerable ingenuity by both the contractor and the subcontractor and they have developed several new methods and procedures in the work. This mapping of the Kissimmee River Valley is going to be of considerable use not only to the Corps of Engineers but to many other Government and State agencies and it is an important step toward the completion of the mapping of the State of Florida.



A PART OF A CONTOURED MOSAIC AS DELIVERED TO THE CORPS OF ENGINEERS

Topography and Ground Control Surveys

By ARTHUR C. MILLER
VICE PRESIDENT, MICHAEL BAKER, JR., INC.

AS ALL of us know, any mapping project has its own peculiar problems of methods, planning, and scheduling. The Kissimmee project is no exception. Because it represents a considerable departure from standard practice and the methods used are still in the category of an experiment, it requires more detailed planning than most work of this nature.

Its most important departure from standard practice is the elimination of horizontal control as such. An accurately controlled aerial mosaic has been substituted for horizontal control monuments and stakes.

Our contract with the Corps of Engineers calls for a package job—in other words, a map in 67 quadrangles covering nearly 4,400 square miles. The size of the project is more comprehensible when one considers that it covers an area approximately the size of the State of Connecticut. The north limits of the project are at Orlando and it extends south to midway in Lake Okeechobee. The east limits are in the vicinity of Fort Drum and Holopaw and it extends westward to the heart of the citrus region in Highlands, Polk, and Hardee Counties.

This map, as specified, must be made by the use of a combination of aerial and ground surveying methods. Being essentially a civil engineering and surveying firm, we have sublet all of the aerial photography, preparation of the aerial mosaics, and related work to the Abrams Aerial Survey Corporation. This discussion will, therefore, be confined to those phases of the project which we are performing with our own forces. In general, these operations can be classified as follows: (1) horizontal control for mosaics, (2) vertical control, and (3) topography by both planetable and stereoplotting methods.

HORIZONTAL CONTROL

The requirement regarding the accuracy of the controlled mosaics is that 90 percent of all points on the mosaic shall be accurate to within 0.02 inch (40 feet) of their true geographic position. The remaining 10 percent of the points cannot be less accurate than 0.05 inch (100 feet) of their true geographic position. In order to attain this accuracy it was decided that approximately 200 horizontal control points would be required, strategically spaced throughout the project. All existing control monuments were plotted on a master map of the area. These monuments had previously been established by the U. S. Coast and Geodetic Survey, the U. S. Geological Survey, the Corps of Engineers, and the Florida Geodetic Survey. These monuments are generally along roads or rivers, or are grouped in clusters, and they were so spaced that they supplied only about 50 percent of the necessary control. Then, by the use of chained traverse and triangulation the remainder of the points were established.

VERTICAL CONTROL

The contour interval of the map is 5 feet. The method of contouring is determined by the frequency of the contours. The specification states that where contours are spaced more than ¼ mile apart the planetable method must be used. If the contours are spaced closer together than ¼ mile, a suitable stereoplotting instrument may be used.

Since the controlled mosaic was assembled from photographs having a scale of 1:40,000 the area to be contoured had to be rephotographed at a larger scale. This created the problem of determining in advance the approximate limits of the area to be contoured photogrammetrically. For economic reasons we desired to take the photographs to be used for stereo-contouring during the same period as the high altitude photography. By careful observation of older aerial photographs and field reconnaissance these limits were reasonably well determined. They amount to approximately 700 square miles of area to be contoured photogrammetrically and 2,400

square miles to be contoured using planetable methods. The former lies generally in a strip extending north and south at the west edge of the project in the so-called Highlands area of the State. The point where the Highlands breaks off into the Kissimmee Prairie is the point where the change takes place.

In determining the methods to be used on this project, one of the major problems was how best to place vertical control for the planetable topography. The Kissimmee River flows south through the approximate center of the area, and a number of bench marks already existed along the river. The west edge of the area is adjacent to the Highlands area where bench marks were also plentiful. There were a few existing bench marks along the east side and scattered elsewhere throughout the area. However, much of the area was 15 to 25 miles from any known existing vertical control.

The contract specifies that all points in the area must be within 0.75 foot of the correct elevation. It further specifies that spot elevations must be taken at approximate 1,000 foot intervals. It was immediately obvious, therefore, that a tremendous amount of additional vertical control was necessary.

Inasmuch as we would have controlled aerial mosaics at a scale of 1:18,000 (or 1 inch equals 1,500 feet) and these mosaics would be used as planetable sheets, it was reasonable to assume that almost any point could be readily identified on the planetable sheet. We therefore decided on a level system which called for the extension of level lines approximately 5,000 feet apart in an east-west direction across the area. Approximately every 1,000 feet we would determine a ground level elevation and drive a 5-foot stake. We would then identify each of these points on an aerial photograph. By using this procedure, no horizontal positioning of the bench marks was necessary. The level lines were extended in approximately parallel directions by using hand compasses. The advantage of the level lines is that they give us approximately 20 percent of our ground elevations before we take the planetable to the field, as we are able to transfer the bench marks to the mosaic planetable sheet by simple visual examination in the office.

The closing and adjusting of such a large network of levels created another problem. This was solved by dividing the entire project into 14 sections. An effort was made to run a tight loop of levels around each of these sections so that good closures would be received in the east-west lines as they tie into the perimeter loops of each section. When all lines closed within allowable third-order limits, a least-square adjustment was applied to each section as a unit. There are between 150 and 250 miles of levels in each section and about 3,000 miles of third-order levels in the entire project. After final adjustment, the elevation of each of these 1,000-foot points is entered on the planetable sheet.

TOPOGRAPHY

The work of the planetable operator is then reduced to its simplest possible form. When starting out on a line, he already has an elevation on the line every 1,000 feet and he needs only to set up his instrument over each of these points, measure the height of his instrument and take all the necessary rod readings for 2,500 feet on each side of the line. We have found that a six-man party, consisting of a planetable operator and five rodmen, is most efficient on this work if there is not too much cover or too many irregular features. As there are very few rod readings that cannot be read with the instrument used as a level, a recorder is not necessary. We assign each rodman a strip 1,000 feet wide as follows: the first rodman is responsible for recovering the bench marks ahead and for giving any necessary shots within 500 feet on each side of the centerline, the second and third rodmen are responsible for the area from 500 to 1,500 feet out on each side, and the fourth and fifth rodmen are responsible for the area from 1,500 to 2,500 feet out on each side. With an arrangement such as this, all personnel can confine their activities to a comparatively narrow strip and can travel generally forward at all times. Although we haven't attained it, as yet, we believe that after this

work is underway for a few weeks, a six-man party can cover as much as 6 to 8 square miles per day.

The method outlined is, of course, applicable to the areas having ideal working conditions. Actually there are a number of obstacles that make the scheme less efficient than described. For instance, the cows like to scratch their bellies on our 5-foot stakes and so destroy many of them. When this happens, it is necessary to turn between benches. This cuts down materially on the efficiency of the operation. In many areas the hammocks and cypress swamps are in locations that interfere with this type of procedure. Where these obstacles occur we reduce the party size to four men, in order to maintain the maximum efficiency.

After a quadrangle has been completed in the field, it is thoroughly checked and reduced from its scale of 1:18,000 to the map scale of 1:24,000 by the use of a Saltzman vertical reflecting projector. This reduction is made directly onto the original mosaics in pencil, and then inked. It is then submitted to our subcontractor, who makes a photographic negative from which as many prints can be made as needed.

The area being contoured with stereoplotting methods presented an entirely different problem. As previously stated, this area is that in which the contours are less than 1,320 feet apart. It extends in a strip which averages about 10 miles wide from the vicinity of Venus in the south to Davenport in the north. It includes such towns as Lake Placid, Sebring, Avon Park, Frostproof, Lake Wales, and Haines City, and has an over-all length of about 70 miles.

It was decided to use a Kelsh Plotter, which is a relatively new stereoplotting instrument. The instrument uses two projectors with a 7½-watt light source. In the projectors are placed diapositive glass plates which are 9 by 9 inches in size, or the exact size of the contact prints. The image is projected to a platen on which is also projected the floating mark. The plotting table bearing the platen is free to move throughout the area covered by the stereoscopic model and the contour is traced on vellum by a pencil which is held mechanically in an exact position on the table.

The plan for this stereoscopic contouring had to be thought through before the photographs were made. The final decision was to fly the Highlands at an altitude of 5,400 feet, giving a contact print scale of 1:10,800, or 1 inch = 900 feet, using a 6-inch focal length camera. The plotting scale, using an enlargement ratio of 4½ diameters, is then 1 inch = 200 feet. Since the mapping scale is 1:24,000, or 1 inch = 2,000 feet, a Saltzman vertical reflecting projector is then used to reduce the manuscript by 10 diameters to the mapping scale. This reduction is made directly onto the original copy of the controlled aerial mosaic just as the contours obtained by planetable methods are transferred.

PERSONNEL AND EQUIPMENT

The project is headed by a project engineer and two assistants with headquarters at centrally-located Avon Park. One assistant oversees field work and one oversees

RIG FOR PLANETABLE WORK ON TOP OF A JEEP

stereoplotting and office work. The average staff is composed of 50 people about 45 of whom are field employees and 5 are office employees.

We are using Willys Jeeps almost exclusively in the field and we find them a necessity in the sandy soil of the Kissimmee Prairie. We have developed a very good method of getting about a 10-foot instrument height for our alidades. We designed a welded steel frame which has a 2-inch plank floor covering the entire top of a Jeep. The spring action of the Jeep has been eliminated by four 1-inch round iron braces, each of which is used on each of the four corners of the Jeep to brace the frame upward from the ground. We can then set up the planetable on top the Jeep with adequate room for as many as three people around the planetable. With three people on the top it has not been possible to disturb the level of the alidade telescope.

Another unique device which we have used to good advantage in extending levels is a 10-foot stiff-legged tripod. This has enabled us to run levels through high palmettos and brush without cutting them, thus maintaining nearly the same rate of progress of leveling as in the open areas.

Even though these methods of mapping may not be usable in all areas with satisfactory results, it is our opinion that there are very few localities in Florida that cannot be adequately mapped by them. Due to the sandy nature of the soil most of the State adapts itself very well to stereoplotting methods. Even in areas of dense tree growth there are normally many spots of sand among the trees that are visible on the aerial photographs. This is not true of other parts of the country, and heavy vegetation is one of the things that limits the accuracy of results.

LEVEL EQUIPPED WITH 10-FOOT TRIPOD

Aerial Photography

By W. S. KARR

VICE PRESIDENT, ABRAMS AERIAL SURVEYS

WHEN the Corps of Engineers advertised for bids for the Kissimmee Valley Mapping Project in January, 1950, our company decided to offer our services to Michael Baker, Jr., Inc., as their subcontractor for the flying, aerial photography, laboratory processing, and photogrammetric work which we were best equipped to do. After the Baker company was awarded the contract, we entered into a separate agreement with them, and operations got underway in February of that year. Before the crew actually started flying operations, a considerable amount of estimating, plan-

ning, and coordinating was necessary. These activities were approximately as follows:

(*a*) Preliminary study and outline of requirements

(*b*) Detailed study, including reconnaissance flights over the project area

(*c*) Outline of plan of operations and cost estimate

(*d*) Negotiation with the Baker company and the preparation of an agreement covering the work to be done

(*e*) Notice to proceed with flying operations.

The specifications prescribed a negative scale of 1:40,000; and using a 6-inch focal length camera, this made necessary a flight altitude of 20,000 feet above the ground. We had previously operated our AT-11 Beechcraft airplanes at 22,000 feet above sea level, using oxygen, of course, and anticipated no trouble in using the same equipment on this project. So the Beechcraft was chosen for this job, and gave a fine performance.

The T-5 precision mapping camera was used on this project since it was particularly suited for such work. The T-5 camera was developed by the Air Force to meet the requirements of the Army Map Service and the Corps of Engineers. It has a system of data recording which permits the photography of indicating devices showing altitude, time of day, project name and date, level indication, and negative number in the roll. Standard topographic base 9½-inch wide film was used. Rolls were 150 feet in length and approximately 200 9- by 9-inch negatives were made on each roll. The exposure was generally 1/150 second at *f*/11, and processing was standard.

As stated in the preceding article, part of the area was to be contoured by planetable and part by photogrammetric methods. The latter area amounted to approximately 700 square miles and was to be flown to obtain photography at scale 1:10,800. It was originally estimated that the crew would be at their base of operations 10 weeks to photograph both areas, and that 60 hours of flying would be necessary. The crew was actually on the job at Avon Park from January 25 to April 18, 1950, or 12 weeks, and a total of 96 flying hours were needed to complete the flying operations.

Avon Park was selected as the base of operations since the Baker company's field office was there and it was centrally located for the work. After the crew arrived on the job, the weather, as the natives said, was "very unusual." High winds encountered at mapping altitudes on some occasions reduced the ground speed of our plane to 90 miles per hour and sometimes less. Extremely turbulent air conditions not usually encountered at 20,000 feet made it difficult to keep the plane on the flight line and caused a larger percentage of reflights than was anticipated. One favorable condition with regard to the weather was the fact that, on several days, it was possible to work on the low altitude photography when it was impossible to photograph at the higher altitude.

With the flying and aerial photography out of the way, all efforts were concentrated on the assembly and reproduction work for the mosaic. The specifications call for a variety of photographic materials as follows:

(*a*) Contact prints, 1 : 40,000 and 1 : 10,800 scales

(*b*) Photo index maps

(*c*) Enlargements, 1 : 24,000 scale

(*d*) Mosaic reproduction without contours, at 1 : 18,800 scale on pre-mounted sheets for planetable use

(*e*) Mosaic reproduction, 1 : 24,000 scale without contours

(*f*) Many items generated in producing the above required materials, such as aerial film negatives, copy negatives, original mosaics, control overlay sheets, ratio computation sheets, and radial triangulator templates.

Since many of these items are standard for such surveys, special mention will be made of only the more important ones.

As the mosaic assembly is the key to all the work, it naturally took the most planning and required more labor to produce than any other single item. Actually a new system of mosaic assembly was developed to meet the requirements for the reproduction. The original mosaic quadrangle sections were photographed three times without contours at scale 1:24,000 and at scale 1:18,000 and once with contours at scale 1:24,000

(except for the areas covered by photography but not contoured).

The photography for the mosaics was flown east and west which makes the coverage well adapted for assembly, starting at the southern limit and progressing toward the north. Using control obtained by the Baker company, a radial triangulation net was assembled on a very carefully constructed base. This net took in the east and west boundaries of the job and covered at least two tiers of 7½-minute quadrangles for each subarea prepared for mosaicking. When all radial points were located on the base they were transferred by means of transparent overlays to the mosaic base assembly. This assembly consisted of sections of quarter-inch masonite machined to the exact size of each 7½-minute quadrangle and held together by a special system of parallel wood supports and corner locking screws for mosaicking. When any 7½-minute quadrangle section was completely mosaicked, it was very carefully cut out of the assembly and placed in a special frame. The marginal data were then assembled around all four sides and the names of all important features were placed over the photo image by means of stick-up lettering. When this had been accomplished the mosaic quadrangle section was ready for first copy.

The first copy was at 1:18,000 scale and was for the planetable sheet on which contours were to be placed in the field by the Baker company. The mosaic quadrangle was again copied at 1:24,000 before contours were added. All copies were made on film. Allowances were made for slight variations in dimensions, due to processing, but the over-all size was held to within 0.02 inch, or less. All copy negatives were made to the scale of the desired reproduction and prints were made by contact printing. These operations were the most critical of all the photographic steps in the entire operation. All methods and procedures were carefully checked and found to meet the requirements.

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Graphic Determination of Areas

By HAROLD F. STEGMAN
U. S. COAST AND GEODETIC SURVEY

A GRAPHIC METHOD of solving an area problem, where a preliminary or approximate result is desired, as in many design computations, calculation of earthwork quantities, or in some surveys of land, is frequently the most rapid and economical method to employ. In Gillespie's *Surveying Text,* edition of 1896, is described a graphic procedure for converting any polygon to a triangle of equal area, and the suggestion is made that the area of this triangle be computed after scaling its base and altitude. The methods presented here are a further development of this procedure as applied to several elementary surveying problems.

THE AREA OF A TRACT OF LAND

In figure 1 the polygon *ABCDE* represents a field which has been surveyed with compass and by pacing distances, for the purpose of estimating harvesting costs on an acreage basis. The boundary has been plotted at a convenient scale on a local plane coordinate grid. To reduce the polygon to a triangle of equal area, the part within the triangle *ABC* is first considered (figure 1a), with the purpose of reducing the number of sides in the polygon from five to four.

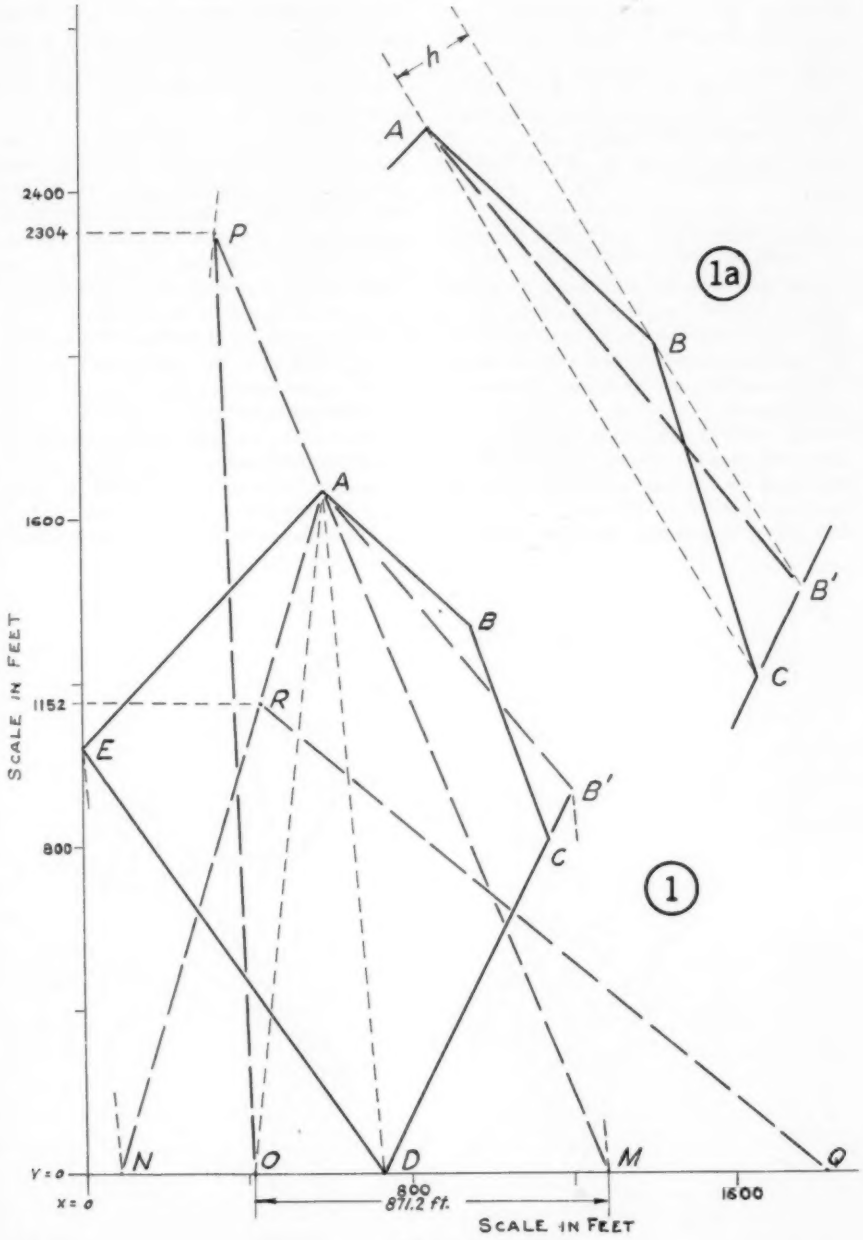
The area of the triangle *ABC* is equal to the product of its base *AC* and ½ of its altitude *h*, so if a line is drawn through *B* parallel to *AC*, point *B*, the vertex of the triangle, may be moved along this line without changing the area of *ABC*. In this case it is convenient to move *B* to point *B′* which is on the prolongation of course *CD*, and thus convert the triangle *ABC* to *AB′C*, which has the same area. *ABCDE* has then been converted to *AB′DE*, or from a five-sided to a four-sided figure of equal area.

Referring back to figure 1, a line must be selected for the base of the triangle to which polygon *AB′DE* is to be converted. In this problem the *x* axis of coordinates is chosen for this base for simplicity in the actual determination of the area, as is later explained. The triangle *AB′D* is converted to *AMD* by drawing from *B′* parallel to the triangle base *AD*, cutting the *x* axis at *M*. Similarly triangle *ADE* is converted to *ADN* by drawing from *E* parallel to *AD* and cutting the *x* axis at *N*.

At this point the area of the field could be computed after scaling the base and altitude of triangle *AMN*. However, if *AMN* is converted to a triangle with a base of 871.2 scale feet, the altitude of this triangle will equal 100 times the area in acres, which can be read directly on the ordinate scale by pointing off two places to the left. This is so because there are 43,560 square feet in an acre, and the area of a triangle with a base of 871.2 feet and an altitude of 100 feet is $\frac{871.2 \times 100}{2} = 43{,}560$ square feet, or 1 acre.

This 871.2-foot base may be placed at any convenient point along the *x* axis. In this case, for the sake of clarity, it is laid off from point *M*, to the left, to point *O*. The line *AM* is then extended, and by drawing from *N* parallel to *AO*, point *P* is located. Triangle *AMN* has thus been converted to triangle *MOP* which has the same area. This is true because triangle *AON*, taken from triangle *AMN* has the same base and altitude as triangle *AOP* which was added to triangle *AMO*. By reading the ordinate of point *P* and dividing by 100 the area of the field is found to be 23.0 acres.

The exactness with which a point can be graphically determined depends in part on the angle of intersection between construction lines, and the solution should be planned with this in mind. In this case the choice of a base equal to twice 871.2 scale feet laid off from point *N* to the right, to point *Q*, would have given a better intersection for the vertex, which would then be at *R*, than was obtained at *P* with the


h
A
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SCALE IN FEET
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R
E
800
B'
C
1
N
O
D
M
Q
Y = 0
X = 0
800
871.2 ft.
1600
SCALE IN FEET

FIGURE 1

871.2-foot base. It would then have been necessary to multiply the ordinate of *R*, 1152 feet, by $\frac{2}{100}$ to obtain the area in acres. Should the area be required in square linear units, a convenient multiple of 2, in this case 2,000 feet, would be selected for the base.

PARTITIONING OFF A REQUIRED AREA FROM A GIVEN TRACT OF LAND

Here the problem is the reverse of that presented above, as the required area is constructed as a triangle on one side of the given polygon as a base, and then converted to fit the outline of the polygon. Two cases are presented.

Case 1.—The polygon *ABCDEFG* (figure 2) represents a 45-acre farm plotted on state grid coordinates, which is to be divided into two equal parcels. It is desired that the farm buildings and the spring be retained in the northerly parcel and, therefore, a preliminary study is necessary before a practical subdivision, following existing field lines where possible, can be suggested to the owner.

The first step is to subdivide the farm into halves by a line beginning at point *P* near the spring. In figure 2, one half of the area of the farm, 22.5 acres, is constructed as triangle *B'KI* at the intersection of two grid lines. *B'KI* is then converted to triangle *A'B'H'* in which *A'B'* equals the length of the boundary course *AB*, *H'* being located by drawing from *I* parallel to *A'K*. Triangle *A'B'H'* is then constructed on side *AB* of the polygon as *ABH* (figure 2) with side *BH* passing through corner *C* of the polygon. Triangle *ABH* is then converted to *ABMG* by drawing *AM* parallel to *HG*. Then, by drawing *CN* parallel to *PM*, *ABMG* is converted to *ABCPNG*. Then point *O*, the end of the required subdi-

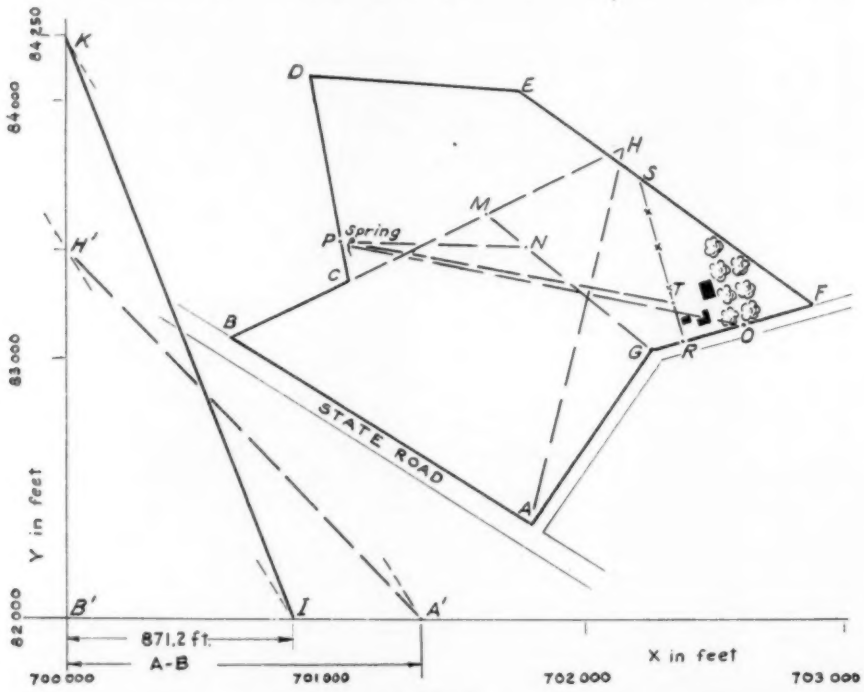


FIGURE 2

vision line *PO*, is obtained by drawing *NO* parallel to *PG*. It is noted that line *PO* is unsatisfactory because it passes through the farm buildings and orchard near *O*.

If it is decided to run the line of partition along fenceline *RS*, the point *T* on that line, such that *PT* and *TR* will be the partition boundary, is located by drawing from *O* parallel to *PR*. Further desired changes can be made in a similar manner, and a tentative location of the boundary selected before the field survey is executed.

Case 2.—Another plat of the same farm is shown in figure 3. The owner has a buyer who offers to purchase a parcel containing 800,000 square feet along the State road with its rear boundary paralleling this road. Before deciding to sell, and incurring the expense of an accurate survey, the owner wishes to know approximately where this line will fall. The problem, then, is to part off the required area by a line running in a specified direction. The 800,000 square foot area is constructed as triangle *B'KI* (figure 3), and transferred to the polygon *ABCDEFG* as *ABJ*, with side *BJ* passing through corner *C*. *CZ* is drawn in the specified direction parallel to *AB*, and *ABJ* is converted to *ABTZ* by drawing *AT* parallel to *JZ*. Then by drawing *TU* parallel to *CZ* triangle *CTZ* is converted to *CUZ*.

Guide line *VW* is then drawn parallel to *CZ*, in the estimated position of the required line such that the area of *CVWZ* will be approximately equal to *CUZ*. Then the parallel edges of two triangles or parallel rulers are passed through points *Z* and *U*, and turned in azimuth until the condition is obtained that points *X* and *Y* where these parallel straightedges cut the farm boundaries, define a line parallel to the guide line *VW*. This line *XY* is the required rear boundary of the 800,000 square foot parcel.

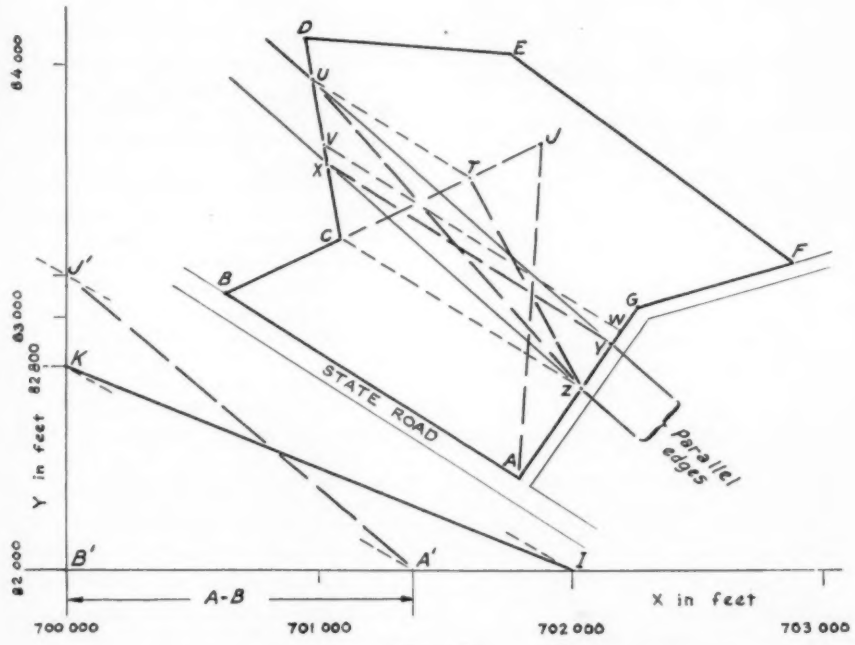


FIGURE 3

CURVED BOUNDARIES

Where a tract is bounded in part by circular curves, its area may be determined graphically if the lengths of the curves are known. One method of replacing such a curved boundary by a straight line for the determination of area is shown in figure 4. The fillet AVB between the curve and its tangents is first added to the original tract, and then an equal area in the form of a triangle is subtracted. This area may be represented by a triangle of base $(2T - L)$ and altitude R, where:

$OA = R$ = Radius of the curve
$AV = T$ = Tangent distance
$CD = L$ = Length of the arc AB.

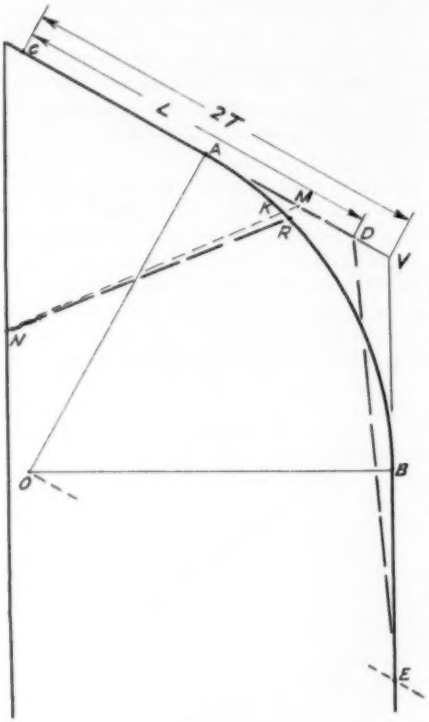


FIGURE 4

The base of the triangle, DV, is determined by laying off a distance T from A, the "point of curve" of the curve, back along the adjacent course to C, and then laying off L from C toward the vertex, to point D. The radius OA is the altitude of the triangle, and E is located by drawing OE parallel to AV. The lines AD and DE then replace the curve AB and line BE for the graphic determination of the area. Curves with central angles approaching or greater than 180 degrees can be treated in two parts.

Where the problem involves the subdivision of land and the required line intersects a curved boundary as at R in figure 4, the closing line NM will cut the construction boundary at M, and the curve at K. The line AK must then be adjusted to compensate for the area of the fillet AMK between the construction boundary and the curve. This is done by substituting a triangle of equal area by estimation, which is constructed on line NK and converted to triangle NRK. The short arc RK may be considered a chord. The result can be verified by a back solution if desired.

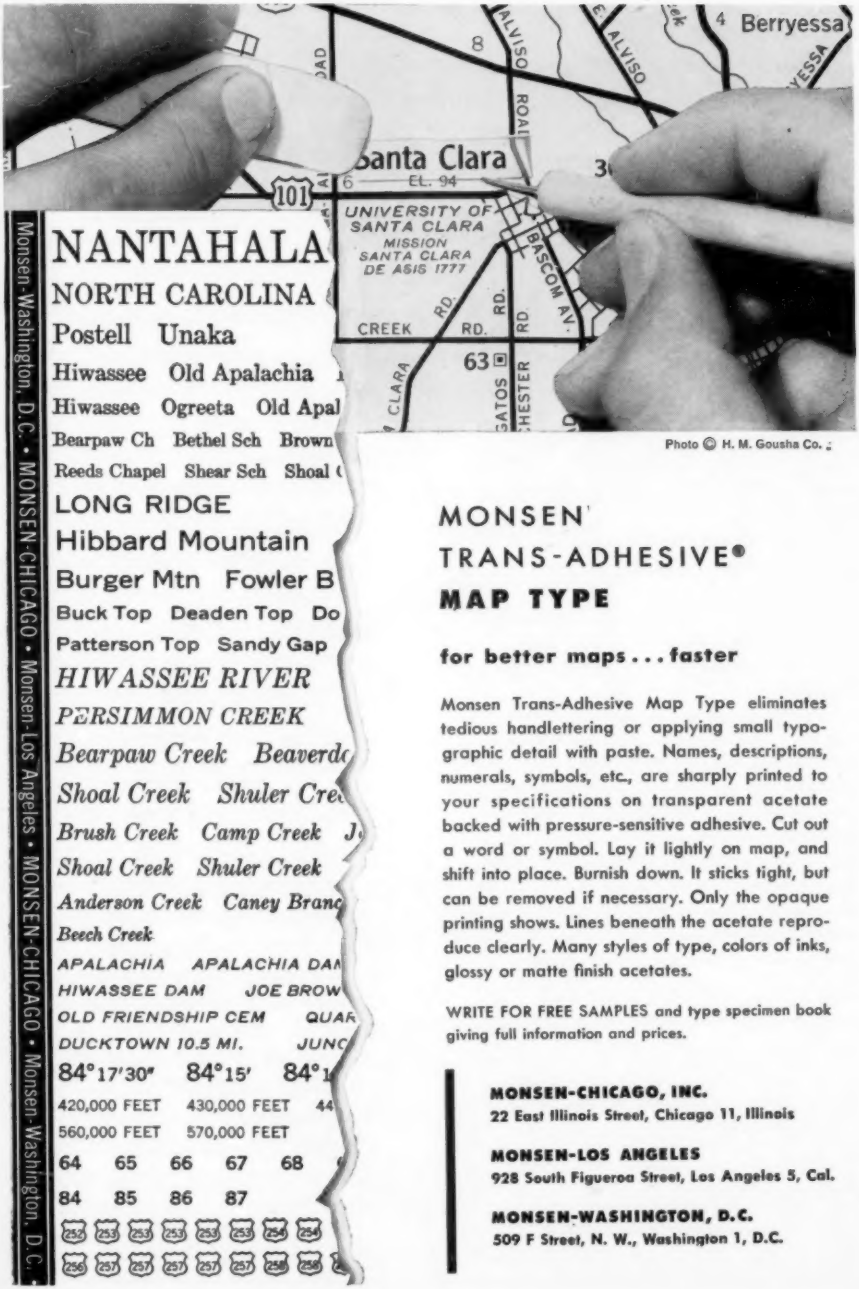
Wisconsin Society of Land Surveyors Meets

THE Fourth Surveyors Institute, conducted by the University of Wisconsin Extension Division and the College of Engineering in cooperation with the Wisconsin Society of Land Surveyors, was held at Madison on November 18, 19, and 20, 1952. Thirty practicing surveyors were enrolled.

The Wisconsin Society of Land Surveyors elected new officers at its annual meeting, held in conjunction with the Institute. The Society plans to continue its work on obtaining legislation for the registration of land surveyors as well as improving legislation concerning metes and bounds descriptions in the State of Wisconsin. The Society now has 68 active members after one year of existence.

The Society has expressed an interest in becoming affiliated with ACSM and has taken definite steps in that direction.

—HENRY A. KALLSEN



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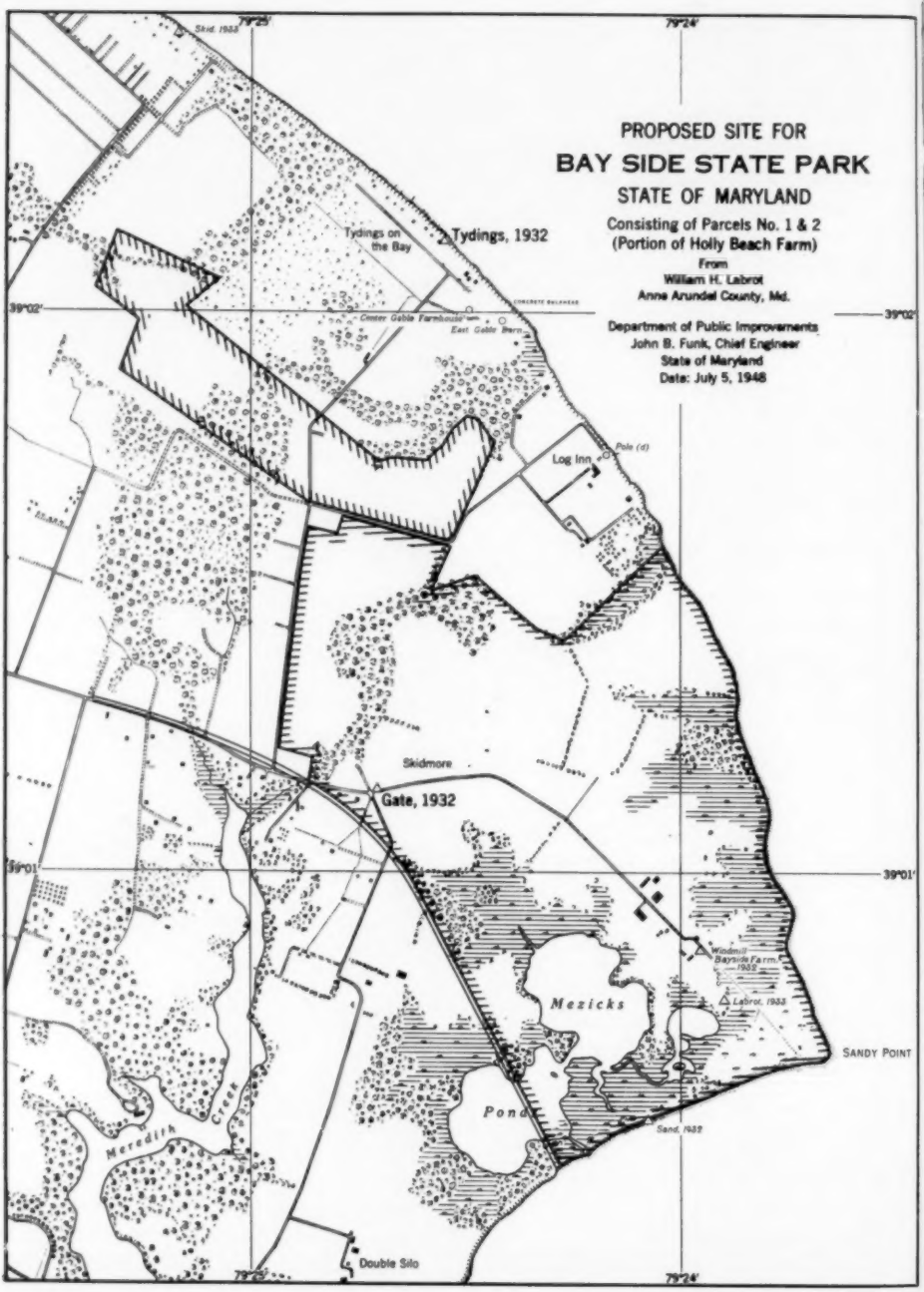

PROPOSED SITE FOR
BAY SIDE STATE PARK
STATE OF MARYLAND
Consisting of Parcels No. 1 & 2
(Portion of Holly Beach Farm)
From
William H. Labrot
Anne Arundel County, Md.
Department of Public Improvements
John B. Funk, Chief Engineer
State of Maryland
Date: July 5, 1948
79°25'
79°24'
39°02'
39°01'
Tydings on the Bay
Tydings, 1932
Center Gable Farmhouse
East Gable Barn
Log Inn
Pole (d)
Skidmore
Gate, 1932
Windmill Bayside Farm 1932
Labrot, 1932
Mezicks
Pond
Sand, 1932
SANDY POINT
Meredith Creek
Double Silo

The Hidden Value of State Coordinates

By DRAPER K. SUTCLIFFE

CIVIL ENGINEER, DEPARTMENT OF PUBLIC IMPROVEMENTS, STATE OF MARYLAND

SEVERAL years ago while supervising survey work of the Department of Public Improvements, State of Maryland, I discovered that state coordinates may have a double, or hidden, value.

My department was authorized to conduct the necessary surveys for the land acquisition of the 650-acre Bay Side State Park. A contract was made with State Registered Surveyor "A" to make a boundary survey and plat of the tracts of land constituting the property. In keeping with the Department's survey policy of using Maryland State coordinates, the horizontal control for this survey was based on the U. S. Coast and Geodetic Survey triangulation station GATE which was located near the southwest boundary of the tract. (*See* illustration on facing page.)

As soon as the boundary survey was completed, additional money became available for the development of the park site and a contract was made with State Registered Surveyor "B" to make the topographic survey. The horizontal and vertical control for this survey was also to be based on station GATE.

As the topographic survey progressed, Surveyor "B" reported a discrepancy in the location of some of the northern property corners. Both surveyors naturally believed that they had used good surveying methods and reasonable care in their work and neither one thought that he could be wrong.

After studying the matter in connection with U. S. C. & G. S. Air Photo Compilation Map No. T-5340, I decided that an independent check traverse from U. S. C. & G.S. triangulation station TYDINGS should be run. This station was about 2,000 feet north of the corners in question, and it was reasonably certain that this traverse would be cheaper and quicker than checking all the computations or resurveying the contractor's traverses.

I formed a field party which included representatives of both surveyors and of the State. Some difficulty was experienced in locating station TYDINGS, and some trial angles had to be observed between nearby intersection stations before TYDINGS was found and occupied. The check traverse was then completed in a couple of hours and the work of Surveyor "B" was proved to have been correct. This enabled Surveyor "A" to locate an error in his computations and revise his work. I am sure that Surveyor "A" has since wished that his original traverses had included this tie to station TYDINGS and that in the future he will make more complete use of the control available near his survey jobs.

The total cost of this job was certainly reduced by the use of state coordinates, and the new control established for the project was permanently marked for possible use in future surveys. A saving was also made by using all available Federal Government maps of that area, not only for survey planning but for the general development planning for the whole project.

❦ ❦ ❦

CORRECTION NOTICE

Our attention has been directed to the fact that the map described on page 425 of the October–December 1952 issue of SURVEYING AND MAPPING, under the heading of "New Map of the Pacific Northwest," is not a new map, having been published in 1947.

The Congress regrets the error, which occurred through misinterpretation of information supplied by the publisher.

1952 Florida Highway and Surveying Conference

IN MAKING any survey, no matter what its original purpose, data are obtained and monuments erected which may be useful for future surveys and maps. In making highway-location surveys, for instance, a tremendous amount of data is collected which could be used by the land surveyor, the government mapping agencies, and other construction organizations. Similarly, data collected by land surveyors and government mapping agencies can be most helpful to the highway engineer in making his highway locations. An exchange of surveying information between the engineer, the surveyor, and the mapper is very advantageous to all three.

With this in mind the Fifth Annual Highway Conference and the Fourth Annual Surveying and Mapping Conference sponsored by the University of Florida were combined into the 1952 Highway and Surveying Conference. It was held on the University Campus on October 23 and 24. There were approximately 250 in attendance and the interest shown in the papers presented seemed to justify the decision to combine the two groups this year.

The conference opened with a paper presented by Lawrence S. Waterbury, partner in Parsons, Brinckerhoff, Hall and Macdonald, New York, on "A Future Plan for Florida Highways." This was a report of a study of the Florida State Highway System made by this firm and its recommendation for future development of the system. The paper was very ably discussed by M. A. Conner, Engineer of Traffic and Planning, Florida State Road Department.

The afternoon session of the first day was devoted to surveying problems relating to highways, with special attention being given to two specific projects of particular interest to Floridians. The following subjects were presented:

"Precise Surveying for the Lower Tampa Bay Crossing," by P. A. Hakman, Project Engineer with Parsons, Brinckerhoff, Hall and Macdonald, with a very interesting discussion by William E. Dean, Bridge Engineer, Florida State Road Department.

"Horizontal Control and Alignment of the Jacksonville Expressway," by William E. Lee, Design Engineer with Smith & Gillespie, Jacksonville, Fla.

The importance of establishing a cooperative working relationship between the highway engineer and the surveyor was emphasized in two papers in the afternoon program:

"Standards for Highway Surveys," by Lt. Comdr. J. E. Waugh, U. S. Coast and Geodetic Survey, Tampa, Fla., with discussion by Jon Beazley, Photogrammetric Engineer, Florida State Road Department.

"Application of Aerial Photography to Highway Location," by W. T. Pryor, Bureau of Public Roads, Washington, D. C., with a discussion by George D. Hardy, Photogrammetric Engineer with Michael Baker, Jr., Inc., Jackson, Miss.

In the evening there was a dinner meeting with 130 guests. Dr. Robert Gregg, Lecturer in Industrial Engineering, University of Florida, gave an interesting talk on current world problems. Burton J. Bell, Public Information Officer, U. S. Corps of Engineers, Atlanta, Ga., presided as toastmaster in a very excellent fashion.

There were two concurrent sessions on the morning of the second day. One was of interest to highway contractors and engineers. The other was for those interested in land surveying.

The Surveying session included the following papers:

"The Relationship Between the Title Company and the Land Surveyor," by Morton McDonald, The Abstract Corporation, DeLand, Fla.

"Legal Aspects of Land Surveying," by S. T. Dell, Attorney, Gainesville, Fla., and John P. Goggin, Civil Engineer and Registered Land Surveyor, Marathon, Fla., with a discussion led by Hugh A. Binyon, West Coast Title Company, St. Petersburg, Fla.

"Surveying Problems of a City Engineer," by James E. Howard, Jacksonville, Fla.

—THOMAS L. BRANSFORD

Mapping for the Development of Natural Resources in Ontario

By F. WELDON BEATTY
SURVEYOR GENERAL OF ONTARIO

THE first requirement in any attempt to plan for the varied and wise use of a country's resources or to solve the land and water problems of an area is the availability of accurate information, recorded in convenient form, concerning the topography, drainage system, land use, soil, and timber and mineral resources. Experience has shown that these requirements can be met best through the availability of aerial photographs, and topographical, timber-type, and soil maps.

The first use of aircraft by the Department of Lands and Forests in Ontario was for forest-inventory purposes in the year 1921. Aerial sketching was the forerunner of aerial photography and still occupies a very important place in forest-inventory work. The first aerial photographs for mapping and inventory purposes were taken by the Department in 1926 and during the next 20 years the technique of forest inventory by the aerial photographic method was gradually perfected by the Aerial Surveys Section of the Department of Lands and Forests. Benefiting from research work carried out in Canada and elsewhere, the Department was prepared to emerge on a fullfledged method of its own after World War II.

In 1946 the Province undertook a programme of an inventory of its forest resources to be carried on for a period of 5 years. The area to be covered included the portion of the Province producing accessible merchantable timber extending from the Kawartha Lakes north to, and beyond, the Canadian National Railway running through Cochrane, Hearst, Armstrong, and Sioux Lookout. In some sections the accessible forest extends some distance north of the railroad. The areas in the northern parts of the James and Hudson Bay drainage areas are sparsely wooded and were not included within the area to be mapped.

Information compiled from the field notes of former surveys of meridians, townships, highways, railroads, stadia traverses of lakes and streams and, when available, stations established by the geodetic surveys, was plotted on the layout floor. The slotted template method was used in the preparation of the planimetric maps. Transparencies were then transferred to the draughting tables and the sketchmaster was used to transfer the detail from the photographs to the base map control. From this information, the tracings were prepared.

By March 31, 1951, the total area covered was approximately 153,000 square miles. Of this, 126,600 square miles were completed under contract by the Photographic Survey Corporation and 26,400 square miles by the Aerial Surveys Section of the Department of Lands and Forests. Planimetric base maps of all the area at a scale of $\frac{1}{4}$ mile to the inch have been completed. These planimetric maps, 15 minutes in longitude and $7\frac{1}{2}$ minutes in latitude, cover an area of approximately 100 square miles. Prints of these maps and prints from the 170,000 negatives are available at nominal charges.

Arrangements were made with the Federal authorities at Ottawa to have the tracings of these planimetric maps photographed and maps at a scale of 2 miles to an inch, covering 1 degree in longitude and 30 minutes in latitude, are printed. To date, eight of these maps have been printed and provisional prints of seven others are being checked before publication. These maps are distributed by both the Department of Lands and Forests of Ontario and the Federal Bureau.

From the sheets of planimetric base maps at a scale of $\frac{1}{4}$ mile to the inch, a series of forest-type maps are being prepared, as the inventory progresses, showing forest conditions and all other features of value in plan-

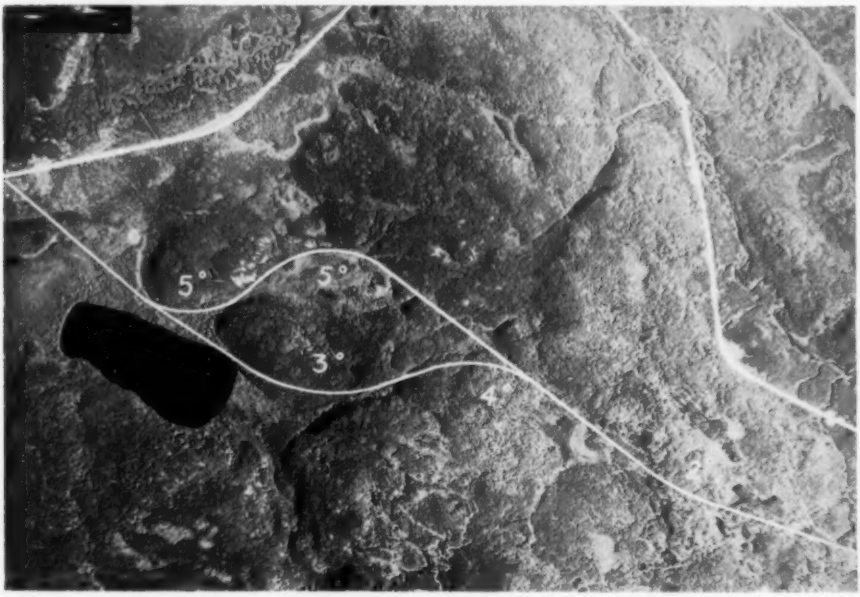
ning forest management. Tabulated statements can be prepared which will show the total volume of merchantable and other timber in a township, watershed, district, or the whole Province. This information will furnish the foundation for the management of the forest resources on a sustained yield basis.

Although this programme was undertaken to obtain an inventory of the timber resources of the Province, the information from these aerial photographs of high quality is contributing to the progress of all phases of the development of our natural resources.

Mosaics have been made of lake areas that are easily accessible by road, and these are used extensively for the disposition of Crown lands as locations for cottages and tourist resorts. Cities have obtained mosaics of enlargements from the negatives to be used for planning and development purposes.

The photographs have proved invaluable to the Department of Highways in determining the location of the Trans-Canada Highway through the rugged Precambrian shield with its innumerable lakes, drainage courses, swamps, and rock escarpments formidable to road building. Study plans are prepared of large areas covering all possible location routes. Soil, swamp, and rock classifications are marked in different colours and rock escarpments are shown. The resulting plan clearly differentiates between the more rugged and inaccessible areas and the flatter soil most feasible for highway construction. On closer examination of the more favourable areas on the aerial photographs, suggested locations can be established and marked on the completed study plans.

Many of the surveyors in private practice in Ontario are acquiring libraries of the photographs of the area where their work is located. From the photographs the work may be planned and estimates made of difficulties that may be encountered and the



ILLUSTRATING THE USE OF AERIAL PHOTOGRAPHS FOR REVISION OF HIGHWAY LOCATION.

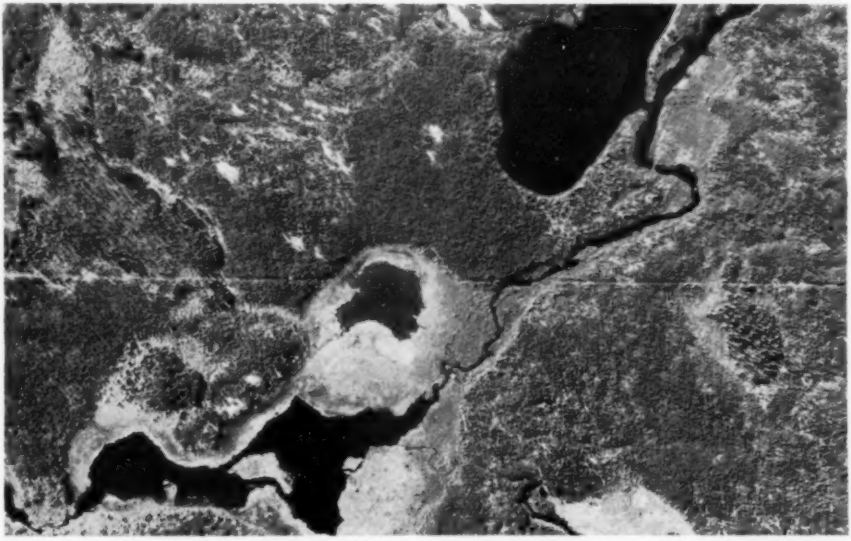
time required for the work. The photographs are useful in assisting clients to explain work that is to be performed, and they are particularly useful in discussing drainage problems.

The land in many of the smaller communities has been deeded without the benefits of registered plans and with ambiguous or incorrect descriptions. This has lead to much confusion in the Registry Offices. Our legislation with reference to surveys and Registry Office provides that a county judge may require a new plan to be prepared. Enlargements of the photographs provide all the details for the surveyor's liaison work with the municipal authorities. Their use speeds up the work and serves as a check on field measurements.

Many of the older surveys in the sparsely settled sections of the Province have become obliterated through lumbering operations and forest fires. The photographs have proved invaluable in retracement surveys to re-establish these former surveys. By careful examination of the photographs and comparison with the field notes of the former survey, the location of the original lines may be determined.

The planimetric maps showing the lakes and drainage systems and watersheds have helped determine the amount of electric energy that may be developed at potential sites of hydroelectric developments and the capacity of storage reservoirs that may be created.

It has been necessary to survey some base lines and meridians to furnish additional control for the mapping. Before commencing such a survey, two parallel strips along the course of the line are photographed. The surveyor pin-points on the photographs the crossings of lakes, streams, and other topographical features. The line is cleared out to a sufficient width so that it can be readily distinguished on the photographs and from the air. After the survey is completed, the line is rephotographed at an approximate scale of 600 feet to an inch and these prints are filed with the field notes of the survey.



TYPICAL EXAMPLE OF HOW SURVEYED LINES APPEAR ON AERIAL PHOTOGRAPHS OF SPARSELY WOODED AND ROCKY AREAS.

Historical Notes on the Divided Circle

By L. C. HIGBEE
PRESIDENT, W. & L. E. GURLEY

THE USE of the divided circle has become so commonplace today that probably little thought is given to its origin. Compass dials, both mariner's and surveyor's theodolites and transits, clocks and watches, micrometer heads, electrical instruments for measuring voltage and current, positioning indicators, tide gages, radio sets, and many other types of instruments employ the movement of an index or pointer through an angle to measure the required quantity.

BEGINNING AND EARLY DEVELOPMENT IN ASTRONOMY

Today, we are primarily interested in the divided circles used in instruments employed in all branches of surveying. Curiously enough, their beginning and early development was in the field of astronomy. Some knowledge of astronomy was a practical requirement of barbaric life, serving as clock and almanac, the recurring celestial appearances determining the times of hunting, fishing, sowing, and reaping. Gradually this familiarity with the heavens developed into a fixed system of observation. Under the centralized governments of China, Egypt, and Babylonia, considerable proficiency was attained in the art of observation, continuity was given to the accumulation of data, and empirical rules were deduced for purposes of prediction, all of which enabled the Greeks to elevate experience into theory.

The division of the circle into 360° has been ascribed both to the Egyptians and to the Babylonians, probably from the circuit of the sun's annual course, alloting 1° for each day in the year. For apparently the same reason the Chinese more accurately divided the circle into $365\frac{1}{4}$ parts from the second century B. C. up to the 17th century, when scientific teachings were conveyed to them by Jesuit missionaries from Europe. The general adoption of the sexagesimal system of subdivision was probably the work of the early mathematicians, inasmuch as 360 is a convenient number, divisible by 2, 3, 4, 5, 6, 8, 9, and multiples thereof.

Other systems of dividing and figuring have been employed from time to time but have never been as universally accepted as the sexagesimal. When the metric system of weights and measures was made legal in France in 1801, at the suggestion of Laplace, the centesimal system, in which each quadrant contains 100 grades, was begun and it is found today in many European instruments. American instrument makers for over a hundred years have divided and figured circles in the decimal system. An unsuccessful attempt was made during the early days of railroad location to popularize the decimal system because of its usefulness in laying out railroad curves. American instruments so divided have been generally made for export only.

Probably the first device that was used to measure altitude was the gnomon, many centuries after the Egyptians, Babylonians, and Chinese had become accustomed to making celestial observations. The Greek historian Herodotus states that the Greeks learned the use of the pole, the gnomon, and the division of the day into 12 parts from the Babylonians. This was the sun dial which has now become an article of adornment on the lawns of country estates.

There is reason to believe that high structures such as temples and tombs were used as gnomons for huge sun dials with inlaid stones of equal width set in the form of a circle to mark the graduations. Thales of Miletus (c. 640–546 B. C.) used the pyramids of Egypt to foretell eclipses, and the axial location of the pyramids in the true

Presented at Twelfth Annual Meeting, American Congress on Surveying and Mapping, Washington, D. C., June 11–13, 1952.

meridian indicates their probable use for celestial observation.

The flow of knowledge from East to West which began about 700 B. C. reached a high point in the founding of the School of Alexandria, about 300 B. C. By constructing the first catalog giving star positions as measured from a reference point in the sky and by increased knowledge in the science of geometry, considerable impetus was given to improving the accuracy of observations. Eratosthenes (c. 276–196 B. C.) constructed an armillary sphere wherewith he measured the obliquity of the ecliptic. Hipparchus (c. 160–125 B. C.) initiated the science of trigonometry and placed astronomy on a sound geometrical basis. He improved on the armillary sphere and invented the planisphere. Armillae (from the Latin *armilla*, a bracelet) were divided circles assembled within a spherical skeleton representing the planes of the horizon, equator, ecliptic, and the meridian, something like the globe of the world which now reposes on the library table in many homes. The planisphere was a projection of the armillary sphere on a horizontal plane. To the armillary sphere, Ptolemy (A. D. 107–161) added sighting tubes attached to a rotating circle thus forming a spherical astrolabe.

For the next 1,400 years the Ptolemaic theory of a celestial system reigned supreme. There was practically no development in instruments during that period. By the end of that period, astronomy had been carried to Europe by the Arabs, Persians, and the Moors.

About A. D. 1230 Frederick II had Ptolemy's publication "The Almagest" translated into Latin and caused the revival of astronomy in Europe. However, no great progress was made until near the end of the fifteenth century when Johann Müller (1436–1476), generally known as Regiomontanus, assisted by Purbach and Bernhard Walther, constructed astronomical instruments. Purbach assisted in translations and Müller constructed a trigonometrical table of sines and tangents which were computed to a radius of seven significant figures for every minute of the quadrant.

After Copernicus published his heliocentric system in A. D. 1543 and during its period of gradual acceptance, it became apparent that certain discrepancies and inconsistencies could be cleared up only by more refined observations.

Regiomontanus constructed a rectangular, or astronomical, radius for measuring the angular distances of the planets, also an astrolabe, and other minor instruments. Long after Regiomontanus, Copernicus was still using an astrolabe. However, in the year 1507, he did erect at Thorn, in Prussia, a quadrant fixed in the meridian above the plane of the horizon. This dates the origin of the fixed observatory. Copernicus also used for altitude measurement a parallactical instrument made of fir, the exact dimensions of which are not a matter of record.

The pinnacle of observation by use of the armilla-astrolabe type of instrument was reached by Tycho Brahe (1546–1601) who devoted his whole life to improving instruments and making observations. Throughout his life he was supported by wealthy patrons and aided by able assistants, the most illustrious being Kepler, who, upon the death of Tycho Brahe was put in possession of his collection of observations and upon which he founded three of the most important discoveries that have ever been made in natural philosophy. Tycho Brahe's contribution lay not so much in providing design innovations but rather by increasing the radius of his instrument. Using the advantage of a long radius, he reduced the probability of error in the spacing of the graduations which he further improved by his own exceptional skill. The long radius naturally led to the use of a quadrant to replace the circle, which was entirely adequate for taking altitudes as they never exceed 90°.

DEVELOPMENT AND APPLICATION IN NAVIGATION

The development of instruments next passed into the field of navigation in the early part of the 15th century, when exploring expeditions began to move out of the sight of land. Equipped with a compass,

cross-staff or astrolabe, and a "Dutchman's log" the day's course was plotted on a folding wooden board.

There is no evidence that compass cards were divided before the voyage of Columbus, who is generally credited with noting that the amount of the variation differed in different localities.

The cross-staff was early used by astronomers and subsequently by navigators for measuring altitudes at sea. It consisted of a short cross placed at right angles to a longer staff, and sliding along it. A sight was placed at the eye end of the staff and at each end of the cross. The angle subtended by different positions of the cross was marked on the staff.

The astrolabe was a simple graduated disk, suspended vertically, with a movable sighting bar pivoted at the center.

Various types of spherical astrolabes were constructed during these years of expanding navigation, but the very considerable error in determining longitude served to nullify any requirement for improved accuracy in measuring latitude. These instruments required sighting in two directions at once, a feat of considerable difficulty at sea.

About 1590, Captain John Davis devised a quadrant that became known as a backstaff, because, in observing, it was held with one's back to the sun. It consisted of two arcs—one for declination and one for latitude—arranged in the same plane with a common center, although of different radii. Quadrants of improved design were made by Elton, Wright, Gunter, Collins, and others.

The construction of the telescope in 1609 by Galileo, the invention of logarithms by Napier in 1614, the invention of the vernier by Pierre Vernier in 1631, the invention of the micrometer in the optical focal plane by Gascoigne in 1641, and the invention of air level by Thevenow in 1670, the use of pendulum clocks and of the plumb line increased tremendously the importance of instrument development during this period.

Of greater importance was the founding of the Royal Society of London in 1662, the beginning of the Royal Observatory in Paris in 1671, and of the Royal Observatory at Greenwich in 1676. Eminent astronomers were appointed to head these institutions, and there was a demand for good instruments. Quadrants became permanent installations in the plane of the meridian and were called mural arches. As the metallurgy of constructing large circles improved, the full circle rotatable upon trunnions combined with a telescope became the practice at observatories. The construction of the first transit circle (1672–81) is credited to Römer.

The invention of the octant by Hadley of England, and independently by Godfrey of Philadelphia in 1731, and of the bubble octant in 1733 brought a reflecting type of instrument into use which made it possible to take observations at sea in the roughest weather. However useful Hadley's instrument was for altitude observations, it could not measure an angle of more than 90°. When the tables of solar and lunar motions prepared by Johann Tobias Mayer were put into practice for measuring longitude, it was necessary for Mayer to construct a full-circle instrument with telescope, mirror, vernier, and tangent motion, and capable of taking readings at different parts of the circle, thus averaging errors of graduation, centering, etc. Borda of Paris improved upon the Mayer circle by shortening the process of observation. In 1796 Edward Troughton made further improvements by using three verniers spaced 120° apart.

DEVELOPMENT IN SURVEYING

So far the use of graduated circles has been discussed only in the field of astronomy and navigation. In surveying, the earliest recorded use seems to have been in the dioptra as described by Heron the Elder (c. 150–100 B. C.). The next instrument to appear was the mine compass, described by Agricola in 1556, which used a dial divided into hours and quarters. Next, in 1571, Thomas Digges published a description of the first theodolite, a term applied particularly to the divided horizontal circle. No great improvements occurred during the next hundred years until Jesse Ramsden (1735–1800) constructed the dividing en-

gine and the General Roy theodolite for triangulation work in England.

Ramsden set the pattern for the direction type of theodolite. Later the French devised the repeating type. Both types have been continued to the present time, the only changes being reductions in size and improvement of mechanical and optical details. These details are not a part of this paper, but are important in their requirement of precisely divided circles of diminutive diameters on both glass and metal. Thus, the Ramsden and Troughton theodolites reading to 1 second had a diameter of 36 inches, the Parkhurst theodolite with similar reading had a diameter of 9 inches, and the Army optical-reading theodolite is now down to 4 inches for a 1-second reading.

Up to the time of Ramsden the dividing of circles depended upon certain individuals who possessed extraordinary skill, manual dexterity, knowledge of mathematics, and perseverance.

The astrolabes of Hipparchus and Ptolemy were probably divided into 360° but the methods employed are not a matter of record. The first tool must have been the beam compass, for a scale could be prepared by continual bisection and Ptolemy had prepared a table of chords for each half-degree of arc. The limb of the parallactical instrument by Copernicus was subdivided into 1,414 equal parts in the quadrantal arc, thus each division represented 3′ 49″.137. Tycho Brahe marked his smallest divisions to 10′ each, and finer readings even to 10″ were indicated by triangular diagonals. As astronomers perceived that more accurate measuring devices were required, graduation became an art to which the special talents of devoted men were dedicated. Men like Abraham Sharp, John Bird, John Smeaton, Jesse Ramsden, John and Edward Troughton, William Sims, and Andrew Ross, were particularly adept in original dividing. Neither time nor space will permit a detailed description of the methods these men employed. It is sufficient to say that the circles, or arcs, were of long radius, and continuous bisection was generally employed.

With the invention and perfecting of the dividing engine by Ramsden in 1777, small circles could be cut with increased accuracy and rapidity. These machines have been under continuous improvement both in Europe and the United States. Correcting devices have been applied to multiply the skill of workmen who have applied their lives to the making of dividing engines so that an accuracy of a fractional part of a second has now been reached. Such machines are now made by Société Genevoise of Switzerland and by Watts of London.

Many Americans have worked on improving the dividing engine. William C. Young of the original Young and Sons, Jonas Phelps and Dr. Edward Arms of Gurley, and Adolph Lietz of San Francisco devoted many years to constructing such instruments. Today only Gaertner of Chicago furnishes them commercially.

The research incidental to the preparation of this paper has been extremely interesting. In the words of Montaigne, "I have plucked the flowers from many fields and mine is only the string that binds them together." If this paper serves to stimulate an interest in the beginnings of equipment now in daily use and to express a full measure of gratitude to those who have given, and those who are continuing to devote, years of service to the development and improvement of such equipment, it will have answered its purpose.

MAPS TRACE PLAGUES

A publishing firm has produced the first of two volumes of an atlas of epidemics. Maps show the spread of various plagues. One, for example, traces the route of an infected beggar from village to village in Poland as a result of which 50 persons died of typhus.—*The Evening Star,* Washington, D. C., January 7, 1953.

Cartography in the Seventeenth International Geographical Congress

By BURTON K. ADKINSON

LIBRARY OF CONGRESS

CARTOGRAPHIC PROBLEMS were considered by two different international organizations during the meetings of the Seventeenth International Geographical Congress held at the Statler Hotel in Washington, D. C., from August 8 to 15, 1952. The 32 cartographic papers submitted to the program committee of the Congress were presented at three section meetings of the Congress. Messrs. Ferdinando Gribaudi of Italy and Andre Libault of France were chairmen of the sessions, and Mr. Edward Espenshade, Jr., of the United States acted as Secretary. In addition to these meetings there was a session of the Commission of the International Geographical Union[1] on the International Map of the World (1:1,000,000) at which a report of this Commission was discussed by representatives of various countries. On the basis of the findings in the report and the discussion mentioned above, the Commission presented a resolution to the I.G.U. Executive Board for consideration. The report and the resolution are summarized later. In addition, the United States National Committee, in cooperation with the National I.G.U. Committees of the member countries, arranged a large exhibition of official, commercial, and private cartographic works.[2]

In order to clarify the relationship of the International Geographical Congresses and the International Geographical Union, as well as to show their interest in cartography, it might be well to present a brief historical outline of their cartographic activities.

THE INTERNATIONAL GEOGRAPHICAL CONGRESS AND THE INTERNATIONAL GEOGRAPHICAL UNION

The International Geographical Congress is one of the oldest scientific congresses in existence, its first meetings having been held in 1871. Sixteen quadrennial congresses have been held since that time, although critical world events have sometimes interrupted the 4-year schedule of meetings. Until 1922 no formal organization existed, each congress having its own plan of meeting. However, committees were set up at each congress to study problems and to present recommendations to the succeeding congress. An International Geographical Union was founded in 1922 in connection with the meeting of the General Assembly of the International Research Council at Brussels, Belgium, at which time a president and other officers were appointed to carry on the necessary administrative functions. These officiers are elected every 4 years at a meeting of the Union. The Union is a quasi-official body, members being appointed as representatives of the member countries. Its meetings are held concurrently with the International Geographical Congresses, the work of the two groups being closely coordinated. Committees and sections transact the business of the congresses, whereas the Union has established a series of commissions to work on selected problems. Meetings of these commissions are held intermittently as well as at the time of the Congress.

[1] International Geographical Union. Report of the Commission on the International Map of the World (1:1,000,000). Office of the Secretary-Treasurer, International Geographical Union, American Geographical Society. New York. 32 pages.

[2] The catalog of this exhibition, The Catalog of National Exhibits, XVII International Geographical Congress, Washington, D. C., is available at a cost of $0.65 from the Card Division, Library of Congress, Washington 25, D. C.

CARTOGRAPHY IN EARLIER CONGRESSES

Cartography has always played an important part in these deliberations. At the Third Congress in Venice in 1881 a section on mathematical geography, geodesy, and topography was created. A section on methodology interested itself in the presentation of geographical information on maps, and the problem of standardizing transliteration of geographic names into the Latin alphabet was also raised—a problem which is still very much alive.

The meeting in Paris in 1899 stressed the need for coordination of topographic mapping by participating countries, recommending standard scales (1:100,000 and 1:200,000), uniform measurements (in the metric system), and concordance of conventional signs.

Three years later, in Bern, Switzerland, the concept of the International Map of the World (1:1,000,000) was broached. Succeeding congresses were interested in this problem and at the Sixth and Seventh Congresses, in London and Berlin respectively, a separate International Cartographic Union was proposed and a committee was appointed to investigate the possibilities. The committee was continued through several more congresses, but did not succeed in creating a Cartographic Union.

The first International Conference on the International Map of the World was held at London in 1909, and a second such conference at Paris in 1913. However, preceding this, in 1904, I.M.W. experimental sheets were proposed by France, Germany, and Great Britain. These were not coordinated, however, by a common prime meridian and base parallel.

Reports of the tenth conference in 1913 state, "The new map of the world on a scale of 1:1,000,000 will, when completed 10 years hence. . . ." Such optimism! This same report mentioned the Boston sheet, NK19, by the U. S. Geological Survey.

The 1928 Congress showed interest in projections and mapping through use of photography. This interest has continued and in the Sixteenth Congress in 1949 several papers were directed toward the problems of projections and the use of aerial photography in mapping. Forty-seven papers on cartography were submitted, of which 40 were presented during the sessions. These were addressed to five different problems which had been set up by the Organizing Committee in Portugal. Two actions were taken by the Section on Cartography: (1) that a commission be appointed to review the International Map of the World at 1:1,000,000 scale, and (2) that a commission be appointed to study and encourage the production of a population map of the world at 1:1,000,000.

CARTOGRAPHY IN THE SEVENTEENTH CONGRESS

Twenty-one of the 32 papers[3] were read and discussed during the three sessions on cartography. Seven of the papers were addressed to historical cartographic topics, one was a proposal for the production of I.M.W. sheets for the Antarctic region, 15 reviewed the cartographic activities and products of official and private cartographic organizations, 8 papers outlined techniques for presenting cartographic data, and 1 colored motion picture showed the work of expeditions to study recent eclipses. Limited space prevents review of the papers here, but these will be published, along with a summary of the discussion, in the forthcoming proceedings of the Congress.

Of particular interest to the readers of SURVEYING AND MAPPING would be the following:

(*a*) I.C.A.O.[4] Aeronautical Chart Catalog, Karl E. Lohse, Canada.

(*b*) A Semi-Graphic Construction for the Conical Orthomorphic Projection with One Standard Parallel, Norman Pye, England.

[3] Summaries of papers selected by the Program Committee of the Seventeenth Congress are published in International Geographical Union, XVII International Congress, United States, 1952. Abstracts of Papers, Publication No. 6, available at the National Research Council, 2101 Constitution Avenue, N.W., Washington, D. C.

[4] International Civil Aviation Organization. —Ed.

(*c*) Attivita dell'I. G. M. Durante il Triennio 1949–1951, General Luigi Morosini, Italy. Abstract.

(*d*) L'Opera Geografica del T. C. I. dal 1948 al 1952, Roberto Almagia, Italy.

(*e*) Carta d'Italia alla Scala 1:200,000, General Luigi Morosini, Italy.

(*f*) La Carte Topographique de la France —Evolution Situation Actuelle, J. Maugensest and M. Huguenin, France.

(*g*) Drawing Geological and Other Profiles by Using Photogrammetric Methods, Hans Boesch, Switzerland.

(*h*) The Production and Reproduction of Relief Maps, John C. Sherman, United States.

(*i*) Presentation de Nouvelles Planches de l'Atlas de France, A. Libault, France.

(*j*) Commission d'Etude des Problems Techniques de Cartographie Geographique, Jacques Mallett, Switzerland.

(*k*) Les Travaux Cartographiques du Comite Special du Katanga, Jean van der Straeten, Belgium.

The members of these sessions adopted the following resolutions:

Miss Myriem Foncin of France proposed:

The Cartographic Section expresses the wish that the I.G.U. recommend to the cartographers to date all maps they produce and give:

(1) Date of materials which have been used (surveys, boundaries, statistics, etc.).

(2) Date when the map was drawn.

(3) Date when the map was published.

The date of printing and of new editions will also be indicated with regard to the extent of revisions.

Mr. Pierre Birot of France proposed:

Considering the necessity, for the study and the teaching of geography, to use all the civil topographic maps, and considering the progress of reproduction methods make the secrecy which supposedly cloaks their production without reason and foolish, the Section on Cartography suggests that the I.G.U. recommend to the National Committees that they take steps to remove the last restrictions on map distribution in certain countries.

The following were discussed, but no action was taken on them by the Cartographic Section.

Mr. R. A. Skelton of Great Britain spoke of proposals for a historical catalog of early globes (to 1850) and expressed hope that this work would be undertaken in other countries as it had been in Italy and Great Britain. Mr. Hans Peter Kosack of Germany suggested that a commission be established to discuss the symbols proposed by him for Arctic maps. Mr. Carl Troll of Germany agreed to bring Mr. Kosack's proposal before the I.M.W. Commission of the I.G.U.

THE COMMISSION ON THE INTERNATIONAL MAP OF THE WORLD

This commission[5] had prepared a report (op. cit. 1) based on studies made by members of the Commission during the interim since April 1949 when the Commission was activated by the I.G.U. As the result of this report and the deliberations in the meeting at Washington, D. C., on August 11, 1952, the following recommendations were approved by the Commission:

Recommends that the International Geographical Union:

(1) Do everything in its power to facilitate the transfer of the Central Bureau to the United Nations.

(2) Give its support to such a widening of the functions of the Central Bureau as would facilitate international agreement upon the measures necessary to keep the specifications and productions of the I.M.W. continuously in line with modern international requirements as well as with the particular needs of individual countries.

(3) Set up a committee of cartographic experts to be available to advise the United Nations on behalf of the International Geographical Union as the need arises.

(4) Reaffirm the need for basic topographical mapping throughout the world, not merely as a proper basis for the I.M.W., but also as a first essential in economic and social development.

[5] Members of the Commission were General R. Ll. Brown, Director General of the Ordnance Survey; Professor Leite de Castro of Rio de Janeiro; Dr. John K. Wright of the American Geographical Society, New York; General Louis Hurault, Director of the Institut Geographique National of France; and Dr. F. J. Alcock, Chief Curator of the National Museum of Canada, Ottawa; and as Corresponding Members, Professor Henri Gaussen of the University of Toulouse, France; and Dr. Ronald Miller of the University of Edinburgh, Scotland.

(5) Urge the members of this Congress to keep these aspects of mapping before their governments.

CONCLUSION

This paper has addressed itself to the major activities of the geographic meetings in Washington, D. C., from August 8 to August 15, 1952, which were concerned with some phase of cartography. It does not pretend to mention all activities which had some concern with cartography. For instance, the Commission for the Study of Population Problems in its report has a section on the mapping of population. Other sections of the Congress and the Commissions of the I.G.U. necessarily included some cartographic aspects in their deliberations.

It is the hope of the author that this paper will give the reader a brief summary of the deliberations and indicate sources where further information may be obtained.

The impressions resulting from a review of the papers and reports are as follows:

The cartographic sessions of the Seventeenth Congress and the Commissions of the I.G.U. seemed to concentrate their interest on the following aspects of cartography:

(*a*) Techniques for presenting data on small-scale maps

(*b*) Techniques for use on maps primarily intended for instructional purposes

(*c*) Summarizing the status of cartographic activities in the different member nations (See *Status of Geography,* Publication No. 7, International Geographical Congress, Washington, 1952, as well as several papers presented in the cartography section)

(*d*) The study of problems of historical cartography

(*e*) The encouragement of the production of small-scale maps which are based on detailed surveys and other data.

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News Notes

Allen Hitchings, a member of ACSM and President of the Surveyors' Association of King County, Washington State, furnishes the information that, although the Association is only about a year old, it is making progress toward solution of many problems facing the surveyors of that area and hopes to become affiliated soon with ACSM. Address: 322 Columbia St., Seattle 4, Wash.

Richard B. Mecha, President of the Wisconsin Society of Land Surveyors (organized Nov. 29, 1951) informs that the Society is sponsoring a bill in the Wisconsin Legislature in behalf of registration for land surveyors. Similar bills, previously sponsored by the Wisconsin Professional Engineers in 1949 and 1951, were lost in adjournments. Address: President Mecha, 920 N. 5th St., Manitowoc, Wisc.

Commissioner Jack Taylor, Department of Public Lands, State of Washington, and Raymond F. Reed, Chief Engineer of the Department and Executive Secretary of the Surveys and Maps Agency, write that a bill is being placed before the 1953 Legislature providing funds for implementation of the provisions of legislation enacted in 1951. This earlier act designates the Engineering Department of the Department of Public Lands as the official agency for surveys and maps and defines its powers and duties.

J. B. Lowell, Program Chairman and National Representative of the Georgia Association of Registered Land Surveyors, informs us that a bill, regulating the making and filing of all plats and maps in each county of the State, is being placed before the Georgia Legislature.

George D. Henning, President of the Michigan Society of Registered Land Surveyors, reports that the Society held its annual meeting on February 5, 6 and 7, 1953, at Traverse City, Mich.

THIRD NATIONAL SURVEYING TEACHERS' CONFERENCE
CAMP RABIDEAU, BLACKDUCK, MINNESOTA
August 3–8, 1952

Bottom row: H. B. Aiken, Tenn. U.; G. H. Harding, Ohio State U.; J. B. Butler, Mo. Mines; S. A. Bauer, Cleveland, O.; C. F. Meyer, Worcester Polytech.; A. D. Kidder, GLO (ret.), Terre Haute, Ind.; R. C. Brinker, Va. Polytech.; L. O. Stewart, Iowa State; L. R. Williams, USGS; J. J. Jolly, USGS; F. J. Spry, Cornell; J. W. Comer, Okla. A&M; P. P. Rice, Rutgers; C. A. Egner, Purdue; G. E. Lommel, Purdue; M. F. Rogers, Mich. State; P. B. Newlin, Ariz. U.

Second row: J. A. Schoenberger, M.D., Ill. U.; R. C. Rautenstraus, Colorado U.; M. C. May, N. Mex. U.; J. Thoma, Washington, D. C.; O. J. Marshall, Toronto U.; J. C. Chaderton, Ill. U.; L. A. Smith, Mich. State; W. A. Wintz, La. U.; J. A. Root, Vt. U.; J. O. Liebig, Lehigh; J. B. Parker, Rensselaer Polytech.; C. E. Thomas, Wilkes College; W. H. Raynor, Ill. U.; H. A. Kallsen, Wis. U.; R. C. Johnson, Milwaukee, Wis.; C. I. Aslakson, Sr., USC&GS; C. I. Aslakson, Jr.; M. O. Schmidt, Ill. U.

Third row: C. T. Male, Union; A. J. McNair, Cornell; J. Arendt, Fenn; K. S. Curtis, Purdue; S. B. Irish, Princeton; G. C. Blomquist, Mich. State; L. D. Walker, Ill. U.; E. G. Ericson, Wash. State; F. J. Gallo, Fenn; C. W. Brown, Duke; J. O'Mara, Iowa U.; E. C. Wagner, Wis. U.; M. B. Gamet, Northwestern; R. J. Lubsen, Iowa State; J. T. Richardson, U. S. Bureau of Reclamation.

Fourth row: D. H. Harkness, W. & L. E. Gurley; Bro. B. A. Barry, Manhattan College; J. A. Oakey, N. Dak. State; W. D. Glenn, Vanderbilt; W. W. Graham, Vanderbilt; Don Moody, student, Ill. U.; N. Porter, N. Y. U.; L. Barclay, Tex. U.; J. L. Williams, Ga. Tech.; S. H. deJong, U. of B. C.; R. K. Palmer, Rensselaer Polytech.; L. V. Nothstine, Jr., Mich. State; P. Riemer, Saskatchewan U.; R. T. Howe, Cincinnati U.; A. C. Stiefel, USGS; L. V. Nothstine, Sr., Mich. State.

W. W. Graham, Vanderbilt; Don Moody, student, Ill. U.; N. Porter, N. Y. U.; L. Barclay, Tex. U.; J. L. Williams, Ga. Tech.; S. H. deJong, U. of B. C.; R. K. Palmer, Rensselaer Polytech.; L. V. Nothstine, Jr., Mich. State; P. Riemer, Saskatchewan U.; R. T. Howe, Cincinnati U.; A. C. Stiefel, USGS; L. V. Nothstine, Sr., Mich. State.

Surveying and Mapping News

Members are requested to send in surveying and mapping news items for publication in SURVEYING AND MAPPING.—EDITOR.

CURRENT SURVEYING AND MAPPING LITERATURE

MAGAZINE ARTICLES

A SURVEY OF SINGLE-COUNTRY ATLASES. Norman L. Nicholson. *Geographical Bulletin,* (Department of Mines and Technical Surveys, Ottawa, Canada) No. 2, 1952. (Review of physical properties and content of various atlases of different countries. Author is secretary of the Atlas-of-Canada project.)

NEW ZEALAND, DEPARTMENT OF LANDS AND SURVEY, SURVEYS (ANNUAL REPORT ON) 1952. (Mentions attendance of R. G. Dick, Surveyor-General, at the 1951 annual meeting of the American Congress on Surveying and Mapping.)

COLOURS AND COLOURING. *N. Z. Survey Draughtsmen's Journal,* Vol. 1, No. 8, May 1952. (Practical essay on the aspects of color and the techniques of its application to survey drafting.)

DRAUGHTING EXAMINATIONS, 1952 (LANDS AND SURVEY DEPARTMENT). *N. Z. Survey Draughtsmen's Journal,* Vol. 1, No. 8, May 1952. (Sets of questions broken down into various stages and subjects, with answers to problems.)

DRAWING A CADASTRAL MAP. J. F. Berry. *The N. Z. Survey Draughtsmen's Journal,* Vol. 1, No. 8, May 1952. (Hints to young draftsmen.)

FOREST SERVICE MAPPING. S. Gibson. *The N. Z. Survey Draughtsmen's Journal,* Vol. 1, No. 8, May 1952. (Describes the Forest Atlas and other types of maps utilized in the administration of the New Zealand Forest Service.)

LETTERS FOR LEARNERS, C. Holdsworth, and INTRODUCING CADETS TO LETTERING, A. J. Reid. *The N. Z. Survey Draughtsmen's Journal,* Vol. 1, No. 8, May 1952. (Two articles dealing with instruction in lettering given trainees in the New Zealand Institute of Survey Draughtsmen.)

SETTING OF DRAWING PEN. A. Jamieson. *The N. Z. Survey Draughtsmen's Journal,* Vol. 1, No. 8, May 1952. (Somewhat elementary but lucid instructions for resetting worn drawing pens.)

THE GEODETIC DATUM, 1949. L. P. Lee. *The N. Z. Survey Draughtsmen's Journal,* Vol. 1, No. 8, May 1952. (History of the surveying and adjustment of the New Zealand triangulation net completed in 1949.)

BRITISH GEOGRAPHY AND THE AMERICAN GEOGRAPHICAL SOCIETY, 1851–1951. J. K. Wright. *The Journal of Geography,* Vol. 118, Part 2, June 1952. (Discusses the relation of the American Geographical Society, during its hundred years of existence, to Great Britain and its people.)

MAPPING ROMAN LIBYA. R. G. Goodchild. *The Journal of Geography,* Vol. 118, Part 2, June 1952. (Describes expeditions in 1950–51 to collect information for a map of Roman Libya under the auspices of the Map of Roman Libya Committee of the Society of Antiquaries of London.)

TOPOGRAPHIC HELICOPTERS LEARN ALASKAN TERRAIN IN CALIFORNIA. (News Item.) *Engineering News-Record,* Vol. 149, No. 4, July 24, 1952. (After season of topographic mapping in Alaska, helicopter and airplane crews continue training in similar terrain in California during winter months.)

TEHACHAPI QUAKE LEFT NO NEW LESSONS. (News Item.) *Engineering News-Record,* Vol. 149, No. 5, July 31, 1952. (Comment by professor at California Institute of Technology to the effect that quake produced no results that can be added to knowledge of quake-resistant construction.)

A SUMMARY OF RECENT PROVINCIAL AND TERRITORIAL BOUNDARY SURVEYS. R. Thistlethwaite. *The Canadian Surveyor,* Vol. 11, No. 1, July 1952. (Discusses many interesting aspects of these surveys and difficulties encountered in making them.)

REPORT OF THE FINDING OF A LARGE NUMBER OF EIGHTEENTH CENTURY MANUSCRIPT MAPS OF SOUTH AFRICA. *The Canadian Surveyor,* Vol. 11, No. 1, July 1952. (Portfolio of manuscript maps was found in the files of the Topographic Service at Delft, Netherlands. They had been collected by Governor Van de Graff, one of last Dutch colonial governors of South Africa before the British interregnum of 1795 and brought back to Holland where they subsequently disappeared. Report states maps are artistically drawn and enable tracing the exploration of the Cape Colony from 1750

onward. An album with a selection of these maps was scheduled for publication by the Dutch-African Publishing Company in the early part of 1952.)

SLIDE RULES. Dr. Ernest P. Carmody. *Nautical Magazine*, Vol. 168, July 1952. (Demonstrates the usefulness of various types of slide rules in solving navigational problems.)

SURVEYING AND MAPPING ASPECTS OF THE FEDERAL–PROVINCIAL AGREEMENTS. D. A. MacDonald. *The Canadian Surveyor*, Vol. 11, No. 1, July 1952. (Discusses surveying and mapping work required in connection with making forest inventories as a preliminary to reforestation in the various provinces.)

THE CANADIAN PHOTOGRAMMETRIC RESEARCH CENTRE. T. J. Blachut, N.R.C., Ottawa. *The Canadian Surveyor*, Vol. 11, No. 1, July 1952. (Describes organization of central laboratory, under the administration of the National Research Council, for the development of new photogrammetric methods to benefit all Canadian surveying activities.)

WATER LEVELS OF THE GREAT LAKES–ST. LAWRENCE WATERWAYS. Charles A. Price. *The Canadian Surveyor*, Vol. 11, No. 1, July 1952. (Brief history of the gaging of lake levels with a discussion of the factors affecting those levels and the conclusion that the Great Lakes Basin is still being tilted by forces affecting the earth's crust.)

A WORLD YOU CAN UNDERSTAND. *The Rohm & Haas Reporter*, Vol. 10, No. 4, July–August 1952. (Describes the advantages and the manufacture of transparent plastic terrestrial and celestial globes.)

GYROSCOPIC EQUIPMENT FOR ALIGNMENT, GRADE SURVEYS. James T. McWilliam, Assistant Highway Engineer. *California Highways and Public Works*, Vol. 31, Nos. 7, 8, July–August 1952. (Describes experimentation with odometer and two gyroscopes mounted in a station wagon, and tells of results in measuring distances, azimuths, and grades.)

SALUTE TO THE ASCE. *Engineering News-Record*, Vol. 149, No. 9, August 28, 1952. (Describes founding of the American Society of Civil Engineers and reviews a roster of famous names that have been associated with it.)

SCIENTIFIC THOUGHT THROUGH THE AGES. Dr. Nazir Ahmad. *Nature*, Vol. 170, No. 4322, August 30, 1952. (Discusses the progress of science from the era of Babylonian Culture to modern times.)

A BRIEF ACCOUNT OF THE ALEXANDRIAN ERA OF LEARNING AND ITS BACKGROUND. A. H. Basire. *New Zealand Surveyor*, Vol. 20, No. 8, August 1952. (Discusses the earliest origins of the sciences of astronomy and surveying in ancient Egypt.)

A CENTURY OF ENGINEERING PROGRESS. James Kip Finch. *The Scientific Monthly*, Vol. 75, No. 2, August 1952. (A brief historical summary of the progress in various branches of engineering both before and after the founding of the American Society of Civil Engineers. While surveying and mapping are not discussed, the article will be of general interest to the members of the Congress.)

CENTENNIAL OF CIVIL ENGINEERING. *Civil Engineering*, Vol. 22, No. 8, August 1952. (This periodical devotes a large part of the issue to the Centennial Convocation of Engineers at Chicago in September 1952. Of interest to all members of the profession.)

AERO SERVICE INC. ANALYZES MAP COSTS. *Engineering News-Record*, Vol. 149, No. 10, September 4, 1952. Page 244. (A discussion of factors entering into the cost of municipal aerial surveys.)

PHOTOGRAMMETRY SAVES CITIES TIME AND MONEY. *Engineering News-Record*, Vol. 149, No. 10, September 4, 1952. Page 236. (Describes aerial mapping programs of Raleigh, N. C., and Cincinnati, Ohio.)

EKLUTNA IS USBR'S FIRST PROJECT IN ALASKA. Byron G. Felkner. *Engineering News-Record*, Vol. 149, No. 11, Sept. 11, 1952. (Description of construction of an Alaska hydroelectric power development.)

CHARTING THE GREATEST RIVER IN THE WORLD. F. G. Walton Smith and Henry Chapin. *United States Naval Institute Proceedings*, Vol. 78, No. 9, September 1952. (Historical discussion of the charting of ocean currents with especial reference to the Gulf Stream. Article condensed from Chapter VI of the book "The Ocean River" by the same authors, just being published.)

GEOGRAPHY AND WORLD AFFAIRS. Wilbur Edel. *The Journal of Geography*, Vol. 51, No. 6, September 1952. (Points out the importance of geography in connection with present world affairs and United States foreign policy, and describes results of an identification test, using world outline maps, conducted among students of New York City College.)

ENGINEERING SOILS MAPPING OF INDIANA FROM AIRPHOTOS. Pacifico Montano. *Photogrammetric Engineering*, Vol. 18, No. 4, September 1952. (Discusses background and procedure and provides a photo-interpretation key to the major soil areas of Indiana.)

MAPS IN THE PRIMARY GRADES. Robert Wayne Trail. *The Journal of Geography*, Vol. 51, No. 6, September 1952. (Interesting discussion of teaching methods for training school pupils in the use of maps.)

PANEL ON ACCELERATED SURVEYING AND MAPPING PROGRAM, 18TH ANNUAL MEETING OF THE AMERICAN SOCIETY OF PHOTOGRAMMETRY. *Photogrammetric Engineering*, Vol. 18, No. 4, September 1952.

(A symposium of importance to all members of the American Congress on Surveying and Mapping. Moderator was Dr. J. R. Mahoney of the Legislative Reference Service, the Library of Congress. Participants included Admiral R. F. A. Studds, President of the Congress; Dr. W. E. Wrather, Director of the U. S. Geological Survey; and other leaders in the field of Federal mapping.)

THE AIRPHOTO – INTERPRETATION PROGRAM OF RESEARCH AND INSTRUCTION AT PURDUE UNIVERSITY. Robert E. Frost. *Photogrammetric Engineering,* Vol. 18, No. 4, September 1952. (Describes program which combines instruction with research in highway and civil engineering.)

THE FLOOR OF THE BRITISH SEAS. A. H. W. Robinson. *The Scottish Geographical Magazine,* Vol. 68, No. 2, September 1952. (After discussing recent advances in marine survey, the author goes on to describe the bottom characteristics of the various areas comprising the "British Seas.")

THE MYTHICAL CITY OF COLUMBIA. (Symposium conducted by Columbia River Section of the American Society of Photogrammetry.) *Photogrammetric Engineering,* Vol. 18, No. 4, September 1952. (Realistic discussion of the aerial photographic and mapping needs of a hypothetical area in need of a water-supply development.)

THE SURVEY OF INDIA SINCE THE SECOND WORLD WAR. Brigadier G. F. Heaney. *The Geographical Journal,* Vol. 118, Part 3, September 1952. (Comprehensive account of the current status and activities of the Survey of India, including a brief history of the Survey, the effects of partition, and many other interesting details.)

THE USES OF AERIAL PHOTOGRAPHS IN GEOGRAPHIC RESEARCH. Clifford H. McFadden. *Photogrammetric Engineering,* Vol. 18, No. 4, September 1952. (A discussion of aerial photography as an important tool for geographers.)

WIDE–ANGLE PHOTOGRAPHIC LENS. *Current Topics, Journal of the Franklin Institute,* Vol. 254, No. 3, September 1952. (Describes new Bausch & Lomb Metrogon lens which enables a single aerial photograph to show three times as much area as was previously possible from the same altitude.)

CONTOUR GRADING HIGHWAY MAPS. C. V. Kane. *California Highways and Public Works,* Vol. 31, Nos. 9, 10, September–October 1952. (Describes use of contour maps in locating and aligning highways.)

A NOTE ON HISPANO-MUSLIM ASTRONOMY. Lt. Col. W. A. Garstin. *Empire Survey Review,* Vol. 11, No. 86, October 1952. (A historical note on astronomical and surveying instruments and methods during the middle-ages occupation of Spain by the Moslems.)

HELICOPTERS IN TOPOGRAPHIC SURVEYS. Robert R. Robertson. *The Military Engineer,* Vol. 44, No. 301, October 1952. (Describes employment of helicopters by Corps of Engineers in mapping Alaska terrain.)

NOTE ON AMERICAN PLANE SURVEYING AND METHODS OF INSTRUCTION FOR ENGINEERS. Peter N. Ray. *Empire Survey Review,* Vol. 11, No. 86, October 1952. (Discussion of differences between British and United States surveying practices which lie mainly in terminology.)

OUR SHRINKING GLOBE—A DISCUSSION. K. O. Emery and M. L. Natland. OUR SHRINKING GLOBE—A REPLY. Kenneth K. Landes. *Bulletin of the Geological Society of America,* Vol. 63, No. 10, October 1952. (Discussion of an article by Dr. Landes which appeared in the *Bulletin* for March 1952. Article was cited in "Current Surveying and Mapping Literature" in *Surveying and Mapping,* July–September 1952.)

BOOKS AND PAMPHLETS

DIRECTORY OF COLLEGE GEOGRAPHY OF THE UNITED STATES. ACADEMIC YEAR 1950–1951. J. R. Schwendeman. University of Kentucky, Department of Geography. Vol. 3, No. 1, Lexington, 1952. 154 pp. Maps.

HAMMOND'S NATURE ATLAS OF AMERICA. E. L. Jordan, Rutgers University. 256 pp. Maps, colored illustrations. C. S. Hammond and Company, Maplewood, N. J., and New York, N. Y. 1952. ("This atlas has been written and compiled for nature lovers who are not scientists. It is a general, first introduction to our natural environment and restricts itself to those aspects of nature with which we come into contact in our every day lives: the rocks, trees and wildflowers; the birds and animals; the amphibians, reptiles, fishes and insects." An unique and valuable publication of interest to all age groups.)

PROCEEDINGS OF THE FORTY–FIFTH ANNUAL MEETING OF THE CANADIAN INSTITUTE OF SURVEYING AND PHOTOGRAMMETRY. *The Canadian Surveyor,* Special Edition, 1952.

SURVEY OF INDIA, GENERAL REPORT 1950. Published by order of Colonel I. H. R. Wilson, Surveyor General of India. Printed at the Office of the Geodetic and Training Circle, Survey of India, Dehra Dun, 1952. xi and 71 pp. Maps, illustrations.

—LYMAN D. LYNN

DISTINCTIVE RECENT MAPS

For the reader's convenience, the addresses of publishers and prices of maps are given where this information is available.

—EDITOR

Two maps showing the *Distribution of Arid Homoclimates* in the Eastern and Western Hemispheres, respectively, were issued in 1952 by the United Nations Economic and Social Council. The maps were prepared by Pevereil Meigs to accompany "Development of Arid Land," a report of the Secretary-General of UNESCO on the activities of the United Nations and the specialized agencies. Color symbols on both maps differentiate "extremely arid," "arid," and "semiarid" regions. "Season of Precipitation" and temperature zones are also mapped. "The extremely arid classification is based on rainfall records which show at least one year with rain. The arid and semiarid classifications are based on the deficit of precipitation in relation to potential evapo-transpiration using the index described by Thornthwaite in 1948." Both maps are at the scale of 1:28,500,000. The Eastern Hemisphere map (UN Map No. 392) measures 21 by 31 inches and the Western Hemisphere map (UN Map No. 393) 21 by 18 inches.

Distribution of Plague 1900–1952 is the sixth map issued by the American Geographical Society of New York for its projected "Atlas of Diseases." The present map, as the earlier ones, has been prepared by Dr. Jacques M. May of the Society's staff. It is inserted as a supplement in the October 1952 number of the *Geographical Review*. An interpretation of the map by Dr. May is published in the journal. The map sheet measures 23 by 36 inches and includes separate maps of Eurasia, Africa, North America and South America (scale 1:30,000,000) showing permanent plague regions. Lengths of the plague seasons in the various infected regions are indicated on a world map.

100 of the World's Best Fishing Spots are located on a colored pictorial map copyrighted in 1952 by United Aircraft Corporation of East Hartford, Conn. The 100 places are numbered on the map and keyed to a list which gives the name, type of fish in the locality, and the nearest airport. The face of the map is decorated with pictures of various game fish. The map, which carries no scale, measures 24 by 34 inches.

A South Pole-centered map of the southern hemisphere (*Carte de l'hémisphère Sud*), on the stereographic projection, was published in 1950 by the l'Institut Géographique National (Paris, France). It is printed on two sheets, each of which measures 27½ by 40 inches. The scale varies from 1:14,147,000 at the Equator to 1:28,293,000 at the South Pole. The map portrays generalized relief by hypsometric tints in addition to political divisions and boundaries, towns and cities, and major transportation routes.

Land Utilization Projects (Title III, Bankhead-Jones farm tenant act, July 22, 1937) locates all projects in which the Soil Conservation Service has managerial or other responsibilities. The black-and-white map identifies "agricultural," "isolated settler," "water conservation," "S.C.S. management," and "State management, S.C.S. custodianship projects." The Soil Conservation Service, U. S. Department of Agriculture, issued the map in August 1952. It is at the scale of 1:9,000,000 and measures 12½ by 20 inches.

The Bureau of Reclamation, U. S. Department of the Interior, recently released two maps which deserve mention. *Western United States Showing Location of Bureau of Reclamation Projects* locates projects completed and under construction. Regional boundaries and headquarters are also shown. The map was published in 1950 as the Bureau's map No. X-W-1. It measures 19 by 18½ inches and is at the scale of 1:6,200,000. A list of Bureau of Reclamation Projects occupies part of the map sheet.

Reclamation Activities (of the United States) which was published in January 1951 is the title of the second Bureau of Reclamation map. It shows present and proposed activities west of the Mississippi River. There are small inset maps of Alaska and of the United States showing river basin areas. The map measures 22½ by 32½ inches and is at the scale of 1:6,200,000.

A Map of the Marked Historical Sites of California locates 496 places with greater or lesser significance in the history of the State. The sites are numbered on the map and keyed to a descriptive list which is printed on the verso. The map, copyrighted in 1952 by the Automobile Club of Southern California, was compiled from the official registrations of the California State Department of Natural Resources, by Phil Townsend Hanna and William Webb. Cartography is by Lowell Butler. Enlarged inset maps locate major concentrations of historical sites. The map is colored and the borders carry illustrations typifying California's historical past and its present industrial and agricultural activities. The map measures approximately 39 by 28 inches. No scale is given.

Major Forest Types—Florida was published in 1950 by Southeastern Forest Experiment Station, Forest Service, U. S. Department of Agriculture. It is at the approximate scale of 1:2,000,000 and measures 14½ by 16 inches. Color symbols differentiate eight forest types as well as prairie or marsh areas.

Illinois Authors is the title of an interesting colored pictorial map copyrighted in 1952 by the Illinois Association of Teachers of English, Urbana, Ill. Names on the face of the map locate the birthplaces of the authors, and sketches picture their persons or illustrate some significant aspect or character of their work. A list printed outside the map limits gives the name and works of 45 (not a complete list) of the Illinois authors. The map sheet measures 34 by 22 inches. It was prepared for the Association by Ellen Burkhart, Louise Lane, and J. N. Hook, Chairman. Art work is by Marion Newport and printing by the Lithocraft Printers of Champaign, Ill.

The Louisiana Department of Conservation published in May 1951 an *Oil and Gas Map of Louisiana* at the scale of 1:500,000. It was compiled and drafted by G. O. Coignet of the Louisiana Geological Survey. The map shows, by appropriate symbols, producing and depleted gas and oil areas, as well as proven salt domes, oil and gas pipe lines, refineries, cycling operations, and natural gas plants. This colored map measures 41 by 41½ inches. Lithography is by A. Hoen and Company of Baltimore.

The ever expanding network of air transportation is evident on the map showing *Airports in New York State*. Virtually every county in the State includes within its limits one or more municipal, military, or privately owned airports. The density of fields is especially high for the New York and Buffalo metropolitan areas. Enlarged inset map show distribution for these two regions. The main map is at the scale of 1:1,000,000 and measures 21 by 28 inches. It was prepared by the Bureau of Aviation and published by the New York State Department of Commerce.

Official Oil and Gas Fields of the United States and Canada are located on a new map (copyrighted 1952) compiled by E. C. Jacobson, 315 Mayo Building, Tulsa, Okla. The map is a blueline print and covers most of a sheet measuring 90 by 93½ inches. The scale is 1:2,000,000.

A geologic map of the two small French islands off the south coast of Newfoundland was published in 1950 by the Office de la Recherche Scientifique Outre-Mer, Paris, France (*Carte Géologique des Îles St. Pierre et Miquelon*). The map, which is at the scale of 1:50,000, was prepared by E. Aubert de la Rue, with cartography by D. Laidet. Pre-Cambrian, Paleozoic, Cambrian, and Quaternary formations are identified, as well as intrusive and volcanic rocks. Areas of mineralization are located. Elevations of a number of triangulation stations are indicated. The map is colored and measures 35½ by 27½ inches.

The agricultural pattern of Costa Rica is shown on the *Mapa de Regiones Agrícolas de Costa Rica* published in 1952 by the Ministerio de Economía y Hacienda, Costa Rican Dirección General de Estadística y Censos. The map was compiled by Dr. Arthur W. Peterson, Land Use Economist. It was prepared in collaboration with los Institutos Interamericanos de Estadística y Ciencias Agrícolas (Zone Norte, Programa Técnico de Cooperación).

Colors on the map identify 14 agricultural regions. A legend-table, keyed to the map, includes figures on number of fincas (farms), area in manzanas, and manzanas per rural family for each region. This map is at the scale of 1:1,350,000 and measures 13 by 18½ inches.

The distribution network for electric power in Europe is shown on a map entitled *Réseaux de Transport d'Énergie Électrique d'Europe*. The present item, published in April 1951, is the third edition of the map. It was published by L'Union Internationale des Producteurs et Distributeurs d'Énergie Électrique, 12 Place des Etats Unis, Paris, France. The map shows existing and projected generating plants and substations as well as various classes of transmission lines. The legend is in French and English. Printed on four sheets, each measuring 36 by 33 inches, the map is at the scale of 1:2,000,000.

Nordens Bergrund is the title of a geologic map of the Scandinavian Peninsula and Finland published in 1951 by Generalstabens Litografiska Anstalt of Stockholm. The map sheet includes two maps of the area, each of which measures 21½ by 18 inches. No scale is given. One map shows ancient rocks (Urberg) while the other shows recent deposits. Below the maps is a panoramic sketch depiciting landscapes, with flora and fauna for various geologic periods.

The railroad network of France (through lines and tramways) is shown on a map of *Les Chemins de Fer Français* recently published by Librairie Chaix, 20 Rue Bergère, Paris. Generalized topography is shown by hypsometric tints. The map is colored and has a decorative border. It measures 26½ by 26½ inches and is at the scale of 1:1,500,000.

A new edition (the third) of the *Mapa Geológico de España y Portugal* was issued in Madrid in 1952. It was published for the Instituto Geológico y Minero de España under the direction of His Excellency Sr. D. José García Siñeriz, Inspector General of the Corps of Engineers and Mines. Map compilers include Antonio Almela, José M. Rios, and Carlos Muñoz. Geologic data included on the map was derived from various Spanish and Portuguese sources and authorities. Twenty-five different formations, ranging from Pre-Cambrian to Quaternary are identified by color symbols. The map is printed on four sheets which when joined give an overall size of 42 by 52 inches. The scale is 1:1,000,000.

Carte Géologique de l'Algérie, published in 1951–52 by Service de la Carte Géologique, Gouvernement Général de l'Algérie, is the second edition of a map originally prepared and issued during the period 1933 to 1940. The revised map, at the scale of 1:500,000, was prepared under the editorial direction of Mr. G. Betier, Directeur du Service de la Carte Géologique, with the collaboration of a number of government departments and individual geographers. Color symbols distinguish more than 50 formations within the major groupings of igneous, metamorphic, and sedimentary rocks. The map is in six sheets, each of which measures approximately 32 by 28 inches. The legend is on a separate sheet 14 by 15½ inches in size. The *Carte Géologique* was printed by Gaillac-Monroco et Cie., 15 Rue de l'Estrapade, Paris, France.

The Ministere des Colonies, Commission de Géologie, Royaume de Belgique, published in 1951 a geologic map of Belgian Congo and Ruanda-Urundi (*Carte Géologique du Congo Belge et du Ruanda-Urundi*). It is in four sheets, each measuring 23 by 23 inches. The scale is 1:2,000,000. The map was prepared by L. Cahen and J. Lepersonne of the Musée du Congo Belge, and printed at Brussels by the Institut Géographique Militaire. The various formations are appropriately colored on the map and keyed to the legend which is printed on one of the map sheets. A four-page booklet (Notice Explicative), prepared by the map compilers, accompanies the map.

Maroc, Carte Economique is the title of an economic map of Morocco published recently by the Direction de la Documentation, Secrétariat Général du Gouvernement (Morocco). Pictorial and color symbols locate various types of industries and mines, and show distribution of various crops, animals, and dominant culture types. The map also shows several classes of roads as well as railway lines. The electric power distribution system and the irrigation pattern are shown on a reduced inset map. The main map measures 23 by 32 inches and is at the scale of 1:1,500,000.

The Army Map Service, Corps of Engineers, published in 1952 a map of *The Near East* at the scale of 1:5,000,000. Relief is not shown, but sand areas, oases, swamps, salt flats, intermittent lakes and streams, and canals are indicated. Cultural features mapped include cities (6 population classes), pipelines, pumping stations, motorable routes, and railroads with three types of gages. There is an inset map of the Nile Delta at the scale of 1:1,250,000. The map is colored and measures 29½ by 37 inches.

Distribution of Moslems is shown on a new map entitled *Les Musulmans dans le Monde*. It was published, as Carte No. 55, by the Direction de la Documentation, 14–16, Rue Lord-Byron, Paris (8e), France, and printed by the Institut Géographique National. Vari-colored dots and symbols identify the different Moslem subgroups. The map includes the entire continent of Africa, the southern parts of Europe and Asia, the East Indies, and the western half of Australia. Syria and Libya are shown in an enlarged inset. The main map is at the approximate scale of 1:17,000,000 and measures 27 by 39 inches.

A relief map of *Israel* at the scale of 1:400,000 was published in December 1950 by the Survey of Israel. It is subtitled "Jubilee Map of the Jewish National Fund." Generalized topography is depicted by graded hypsometric tints. Administrative boundaries, roads, railways, villages and towns, and other cultural features are mapped. A marginal list of "Towns and Jewish Villages," keyed to the map grid, is an especially welcome supplement to the map. Settlements of the Jewish National Fund are identified by asterisks on the list. The map is 42 by 16½ inches in size.

In 1951, the Survey of Israel published a three-sheet topographic map of the republic at the scale of 1:250,000. As on the map described above, elevations are shown by graded color tints. The sheets measure 23 by 26 inches. The Palestine (Mandate) boundary, the Armistice Line, and the Demarcation Line of the Demilitarized Zone are shown.

Die Natürlichen Wälder und Gehölzfluren Irans by Hans Bobek maps the distribution of natural forest and coppice regions in Iran. Color symbols differentiate a number of types of humid forests, transitional forests, and dry forests. The northern limits of date culture and plant-free areas are also delimited. The map is at the scale of 1:4,000,000 and measures 18½ by 19½ inches. It was issued as a supplement to "Erdkunde, Archiv für Wissenschaftliche Geographie," Band VI, Heft 2/3, 1952 (Ferd. Dümmlers Verlag, Bonn, Germany). The map illustrates an article by Bobek entitled "Beiträge zur Klima—Ökologischen Gliederung Irans."

The Surveyor General of Pakistan issued in 1952 a *Highway Map of Pakistan* at the scale of 1:3,168,000. In addition to several classes of highways, railways (several gages), internal and international boundaries, hotels, rest homes, telegraph lines, gasoline filling stations, towns, villages, and administrative centers are shown. The map sheet measures 20 by 27½ inches and includes separate maps of East and West Pakistan, and Junagadh and Manavador at the 1 inch to 50 miles scale. There are inset maps showing Pakistan and Surrounding Countries (1:45,000,000) and Steamer Services in East Pakistan (1:3,168,000).

—Walter W. Ristow

Books in Review

NORDISK SKOLATLAS—FOLKSKOLUPPLAGAN. Edited by Wison Ahlmann, Carl M:son Mannerfelt, Gösto Lundquist, and Gustaf Wilske. *Svenska Bokförlaget,* Stockholm, Sweden. 1951. 36 pages. Swedish text.

Under the leadership of Dr. Carl Mannerfelt, Professor of Geography at the University of Stockholm, the Swedish firm, Generalstabens Litografiska Anstalt, has produced a number of excellent and original educational wall maps in recent years. To these has now been added the *Nordisk Skolatlas,* which is appearing in several editions according to the educational level for which each is designed. The one under review here is the elementary school edition, consisting of 36 pages of maps printed in 8 colors, and constituting one of the most attractive school atlases ever produced in any country.

Although in Swedish text, and with approximately one-third of its content devoted to the Scandinavian countries, the *Nordisk Skolatlas* should be of more than usual interest to American educators and geographers. Its most original contribution to educational method is found in the presentation of the continents by means of six pairs of facing maps, one of which in each case combines bold, shaded relief with types of vegetation and cultivation, while the opposite map depicts physical and political relationships by means of elevation tints, relief hachuring, ribbon political boundaries, selected cities with graded symbols, and a simplified railroad pattern. In addition to the relief-vegetation-cultivation maps of the continents, there is one of the same type for Scandinavia at the scale of 1:5,000,000.

While the nomenclature of the maps is undoubtedly dictated by the purpose and function of the atlas in relation to educational requirements in Sweden, there are some apparent incongruities in usage. It is difficult to understand why Salt Lake City should be the only city name translated into Swedish in the map of the United States, when such names as Rock Island and Grand Rapids lend themselves equally well to translation.

In cartographic techniques, attractive use of color, simplicity of content, and legibility of names, the *Nordisk Skolatlas* has established a standard of achievement which places it high among the various national school atlases of recent years. It is unfortunate that the elementary school curriculum in this country does not require such an atlas for American schools.

CARL H. MAPES

Rand McNally & Co.

HIGHWAY CURVES. Howard Chapin Ives, C. E. Fourth Edition by Philip Kissam, C. E., Professor of Civil Engineering, Princeton University. *John Wiley & Sons, Inc.,* 440 Fourth Avenue, New York 16, N. Y. 1952. Part I, text 195 pages; Part II, tables 388 pages. $7.00.

This modern book on highway surveys is a bargain. Part I, the text, has 65 pages of good information on location procedures, topography, aerial surveying, mapping, and other field and office procedures, in addition to the information on highway curves.

The curve data has been molded into good modern form by Professor Kissam. This edition is descended from Wm. H. Searles' "Field Engineering, a Handbook of the Theory and Practice of Railway Surveying, Location and Construction," copyrighted March 1, 1880, through Howard Chapin Ives' "Highway Curves" first edition of August 1929 to this fourth edition of June 1952. With such sterling genealogy, there can be no question as to the quality of the new edition.

For simple and compound curves there are 12 sets of tables. These include all the elements necessary to develop the characteristics of any curve selected to fit a particular location. Searles' spiral is fully described and there are four sets of tables which provide all the information required for its use. This spiral has been successfully used on railway alignment for almost a century and it most certainly is suitable for highway-curve transitions. The book has three excellent tables of logarithms and logarithmic trigonometric functions, four tables of natural trigonometric functions, the customary tables of functions of numbers, six tables of conversions, trigonometric formulas, and brief explanatory information on each table. The tabular material is excellent and well worth the price of the volume.

The text briefly discusses the use of the State Plane Coordinate Systems developed by the Coast and Geodetic Survey. This short state-

ment is as much as could be expected to be included in a handbook. It is hoped that it will arouse the curiosity of some highway engineers so that they will be encouraged to learn more about the subject.

The text and tables for simple and compound curves are based on the arc definition which has been adopted for highway curves rather than the chord definition which has always been used for railway curves. This change and the voluminous discussions on the theory of spiral curves has brought about a condition which was dubbed by a railway engineer as "tableitis." The chord definition has always seemed to this reviewer to be simpler than the arc definition. It was used by railway engineers to locate the vast mileage of excellent rail lines in this country. If Professor Kissam revises this book again, perhaps in the next issue he can return to the chord definition and simplify the highway procedure. It does seem that some reference should be made in the text to the standards of accuracy that were adopted by the Congress for highway surveys and issued as a "Policy on Highway Surveys."

Highway Curves and *Field Engineering* should be included in every highway engineer's library.

J C CARPENTER
U. S. Bureau of Public Roads

AERIAL MAPPING AND PHOTOGRAMMETRY (Second Edition, revised). Dr. Lyle G. Trorey. *Cambridge University Press,* 1952. 180 pages. Illustrated. $6.00.

This, the second edition of Dr. Trorey's book first published in 1950, presents in an organized manner and in simple and clear language, a collection of graphical and analytical methods applicable to the compilation of maps from aerial photographs. The book also contains chapters on the principles of perspective, the principles of stereoscopic plotting instruments, the multiplex projector, and parallax and elevation calculations. A new appendix has been added describing the Kelsh Plotter. Misprints and errors in the first edition have been corrected, and footnotes have been added referring to latest knowledge.

For the most part, the methods presented require only the most simple laboratory instrumentation for application. They are described so that the procedure may be understood by the ordinary practitioner without extensive background or training in photogrammetry. No effort is made to develop many of the formulas, but liberal use is made of examples carefully worked out so that the application is made clear.

About one third of the book is devoted to oblique photography and presents graphical and analytical methods of measuring angles and heights of objects from obliques. The construction and use of perspective grids and the so-called four-point method of transferring detail from a photograph to a map projection are also described. The remainder deals chiefly with the vertical photograph and includes descriptions of methods of determining heights from measurement with a parallax bar, graphical and mechanical radial triangulation, as well as a chapter on the multiplex projector in which methods of aerotriangulation adjustment are given.

In addition to the description of the Kelsh Plotter, the appendix contains a description of the standard mapping procedures of the Royal Canadian Engineers and a discussion of considerations governing the minimum contour interval of the multiplex and the stereoplanigraph.

This book is truly a manual and should be most useful as a reference, especially to the photogrammetrist who may have occasion to make use of graphical and analytical methods for solution of photogrammetric problems.

JOHN T. PENNINGTON
U. S. Army Engineer Research and Development Laboratories

LA PHOTOGRAMMÉTRIE APPLIQUÉE A LA TOPOGRAPHIE. R. Daniel. *Editions Eyrolles,* Paris. 1952. 438 pages, 358 figures, paper bound. 388 francs.

This French book is a comprehensive treatment of the science of photogrammetry as used in mapping, containing descriptions of many methods and instruments used not only in France, but also in other countries of the world. It is similar in scope and treatment to other recent works by Dr. Zeller of Switzerland, Dr. Schwidefsky and Dr. Finsterwalder of Germany, and the *Manual of Photogrammetry* by the American Society of Photogrammetry.

The position of the author well qualifies him to prepare the treatise. He is Chief Geographic Engineer at the Institut Geographique National, which is the principal central federal mapping agency of France. Mr. Daniel also serves as

professor at the Special School of Public Works.

A list of some of the chapter headings gives a fairly complete idea of the contents: elements of optical theory; lenses of aerial photographic cameras; principles of photography; the human eye; depth perception; stereoscopy; historical development of photogrammetry; principles of perspective geometry; rectification; terrestrial photogrammetry; aerial cameras; aerial photography; general theory of relative orientation; stereoscopic plotting instruments, including the Poivilliers, Zeiss, Wild, Nistri, Santoni, Bausch and Lomb, and other instruments; aerotriangulation; large scale mapping; planimetry; contouring; radial plotting; trimetrogon mapping, simplified stereoscopic plotting instruments; earth curvature and atmospheric refraction.

Extensive discussions of the fundamental topics of rectification, relative orientation, and stereoscopic instruments are illustrated with ample well-chosen diagrams. The basic geometry of the aerial photograph is emphasized throughout the text. Photographs of the principal instruments of the world are included. Other outstanding topics are descriptions of: radial plotting with cardboard templets; aerial cameras having automatic glass-plate magazines; the Fairchild Stereocomparagraph; the Nistri Stereographometer; sketchmasters; and the KEK plotter.

Realizing that Poivilliers plotting equipment is widely used in France rather than the types of equipment usually found in American organizations, one is not surprised to find the multiplex illustrated by an obsolete design. Although the reviewer is not thoroughly familiar with the shapes of the earliest Bausch and Lomb instrument, he is inclined to believe the illustration is one of German rather than American origin. It is noted that the older Gallus-Ferber photorestituter is described and illustrated whereas the contemporary popular American Kelsh plotter is not mentioned.

Although the basic theory of the motions of relative orientation is demonstrated, the recent practical applications of M. Poivilliers are not included, nor are the methods of Dr. Hallert and Dr. Zeller. In this respect, the book is a theoretical rather than a practical treatise. The text is presumably intended for the French engineer who is studying the subject for the first time. It covers the basic theory of the subject very well, but the practical phases of the student's training must be attained by working with the instruments and in photogrammetric mapping offices.

Insofar as the reviewer knows, the treatise is the only writing of its kind in France, replacing the earlier publications *Manuel de Photogrammétrie,* 1948, and *Éléments de Photogrammétrie,* 1949, of the Institut Geographique National.

G. C. Tewinkel
U. S. Coast and Geodetic Survey

ASTRONOMY APPLIED TO LAND SURVEYING. R. Roelofs (University of Delft). *N. V. Wed. J. Ahrend and Zoon,* Amsterdam. 1950. 259 pp.

This book, written in English, was intended to fill the needs of land surveyors in determining positions and azimuths by astronomic observations. Although its scope is broader than would be required by most American land surveyors, it would be of interest to anyone desiring a thorough treatment of the fundamentals of positional astronomy.

The methods described are suitable for observations with conventional precision theodolites and the special equal-altitude types. Familiarity with the conventional type is assumed, but descriptions are given of the 30° and 45° zenith-distance prismatic astrolabes, prism attachments for converting a theodolite to an astrolabe, and the pendulum astrolabe developed for the U. S. Air Force by Willis.

The author begins with a good treatment of the relationship between astronomic and geographic (geodetic) coordinates. Astronomic coordinates are discussed in considerable detail, including such refinements as the reduction of star positions from mean to apparent places, and the reduction for short-period nutation terms. Most of the major national ephemerides are described, including "American Ephemeris and Nautical Almanac" and "Apparent Places of Fundamental Stars," widely used by United States organizations. This section is quite adequate not only for the purpose intended by the author, but also for first-order field astronomic determinations.

The sections on time, corrections to observations, and time-keeping instruments are comprehensive enough to apply to all types of field methods. There are brief but illuminating chapters on the use of the mean value of several observations, and on estimation of accuracy to be obtained with medium- and high-accuracy theodolites.

Techniques for determination of latitude, longitude, and azimuth are extensively covered.

with special attention paid to the various sources of random and systematic errors. The discussions on the economics of observing would be of great value in obtaining a given accuracy of result with a minimum of observing.

Many tables, worked examples, and nomograms nicely round out this text and reference book on positional astronomy. It reflects care and thoroughness in preparation and should be of real value to American students of advanced surveying and geodesy.

DONALD A. RICE
U. S. Coast and Geodetic Survey

DESCRIPTION AND SURVEY IN TITLE, CALIFORNIA LAND TITLES.

William C. Wattles. *Title Insurance and Trust Company,* Los Angeles. 1951. 121 pages, typewritten and lithographed.

This publication is a syllabus of lectures, papers, and research by the author on description and surveys in their relation to California land titles. The author is well known in the property surveying profession and is a former chairman of the Property Surveys Division of ACSM. He is particularly well-qualified to write on the subject from his many years of practical experience as Chief Engineer for the Title Insurance and Trust Company of Los Angeles, Calif.

The author, in his preface, states that ". . . frequent errors of description . . . and litigation arising therefrom, indicate the need of a treatise on the construction and interpretation of descriptions of real property. . . ." The publication deals, in detail, with the many exacting requirements for a complete, unquestionable, legally valid description of land that, from the engineering viewpoint, can, by study of its content, together with an analysis of plats, field survey notes, adjoining deeds, and other pertinent documents, be interpreted in only one sense. Also emphasized is the need for satisfying both the title lawyer's and the surveyor's sometimes separate, though never conflicting, requirements. The theory presented, although developed mainly from problems arising in California, is generally applicable, with caution and due regard to local statutes, to other parts of the United States.

The first section deals in detail with the interpretation of survey data as it is presented in a description and discusses at length the preferable forms of such presentation. Other sections deal with sectionized lands, easements, tidelands and water boundaries, mining, and physical location by survey of described lands. This reviewer believes that the most generally interesting sections are the first one on the general and specific requirements of a description and a succeeding section on "Words and Phrases." This latter section gives exact, legal definitions of many of the terms commonly used in descriptions, with cautioning notes not only on what they really mean, but also on what they do *not* mean. The author has also noted an aversion to the common legal practice of using a long series of more or less synonymous terms to load the description with excess verbiage that adds less than nothing to either exactness or clarity.

Any land surveyor will find this publication to contain much useful common-sense information not otherwise available, on the best practice in phrasing descriptions and in the interpretation of descriptions into actual physical location of boundaries on the ground. He will not, however, find references to actual cases in law, although the author states that his conclusions and principles are based on many actual cases that have come to his attention during his long experience as engineer for one of the largest land title companies in the United States.

This publication is not for sale, but anyone needing it in connection with his professional work may obtain a copy through the courtesy of the author and the publisher by addressing a request, on his letterhead, to W. W. Robinson, Public Relations Officer, Title Insurance and Trust Company, 433 S. Spring St., Los Angeles 13, Calif.

RALPH MOORE BERRY, *Chairman*
Property Surveys Division, ACSM
U. S. Coast and Geodetic Survey

MAP INFORMATION

This department was inaugurated for the purpose of bringing to the attention of the members information pertaining to the availability of maps, surveys, etc., with particular emphasis on how such material can be procured. Authoritative articles covering this class of information are solicited. It is believed that through an interchange and dissemination of such information maximum benefits will accrue to the surveying and mapping profession.

—EDITOR

Topographic Maps

THE FOLLOWING quadrangle maps were published by the U. S. Geological Survey between September 1 and November 30, 1952. All maps are available with or without the green overprint which indicates woodland. The quadrangle name is shown in capital letters, followed by the county name in upper- and lower-case letters. Where a quadrangle map extends into two or more counties, only that county name is given which contains the place for which the quadrangle is named. For example, the quadrangle CREEL, in *Alabama*, is in parts of Walker, Blount, and Jefferson counties, but only Walker is shown because the town of Creel is in that county.

Maps of areas east of the Mississippi River may be ordered from the Chief of Distribution, U. S. Geological Survey, Washington 25, D. C., and of areas west of the Mississippi River from the Distribution Section, U. S. Geological Survey, Denver Federal Center, Denver, Colo.

Alabama

ARKADELPHIA—Cullman
BLOUNT SPRINGS—Blount
CREEL—Walker
DECATUR—Morgan
LANIERS—Talledega
MOONTOWN—Madison†
VINCENT—Shelby
WARRIOR—Jefferson

Alaska

BERING GLACIER (A-2)*—Third Judicial Division†
BERING GLACIER (A-3)*—Third Judicial Division†
CRAIG (B-2)*—First Judicial Division†
CRAIG (C-3)*—First Judicial Division†
CRAIG (C-6)*—First Judicial Division†
CRAIG (D-6)*—First Judicial Division†
JUNEAU (A-5)*—First Judicial Division†
JUNEAU (A-6)*—First Judicial Division†
TYONEK (D-1)*—Third Judicial Division†

Arizona

COCHISE HEAD*—Cochise†
COTTON CENTER*—Maricopa†
DENDORA VALLEY*—Maricopa†
MOBILE*—Maricopa†
WOOLSEY PEAK*—Maricopa†

Arizona-California

PICACHO*—Imperial

Arkansas

ARDEN—Little River†
BLEVINS—Hempstead†
COLUMBUS—Hempstead
FULTON—Hempstead
HOMAN—Miller
HORATIO—Sevier
McCASKILL—Hempstead
McNAB—Hempstead
MELBOURNE*—Izard
PATMOS—Hempstead†
PISGAH—Pike
SHEPPARD—Hempstead†
SPRING HILL—Hempstead†
WASHINGTON—Hempstead†

Arkansas-Oklahoma

ARKINDA—Little River

California

ADELAIDA—San Luis Obispo†
AGUA DULCE*—San Diego
BANNING*—Riverside†
BARREL SPRING*—San Diego
BEVERLY HILLS—Los Angeles†
BOREGO*—San Diego
CALDOR—El Dorado
CALIENTE MOUNTAIN*—San Luis Obispo
CALIPATRIA*—Imperial†
CAPELL VALLEY—Napa
CARRIZO MOUNTAIN*—Imperial
CHILCOOT*—Plumas
CHUCKAWALLA MOUNTAINS*—Riverside†
CITRUS HEIGHTS—Sacramento
CLARK LAKE*—San Diego
CORDELIA—Solano
COSO PEAK*—Inyo†
CRESTON—San Luis Obispo†
CYPRESS MOUNTAIN—San Luis Obispo†
EAGLE MOUNTAIN*—Inyo†
ESTRELLA—San Luis Obispo†
FAIRFIELD NORTH—Solano
FUNERAL PEAK*—Inyo†
HAIWEE RESERVOIR*—Inyo†
HAMLIN CANYON—Butte†
HEMET*—Riverside
IAQUA BUTTES*—Humboldt†
KEELER*—Inyo†
LA PORTE—Plumas
LEEK SPRING HILL—El Dorado†
LIME MOUNTAIN—San Luis Obispo†
LONG BEACH—Los Angeles†
MARBLE CANYON*—Inyo†
MATURANGO PEAK*—Inyo†
MILFORD*—Lassen
MINERSVILLE*—Trinity
MOORPARK—Ventura†
MT. FILLMORE*—Sierra
MT. VACA—Solano
NORD—Butte
ORLAND—Glenn†
PIERCY*—Mendocino†
PORTOLA*—Plumas
RANCHITO CANYON—Monterey

* Indicates 15-minute quadrangle; all others are 7½-minute quadrangles.
† Indicates map lies wholly within county named.
‡ Indicates availability in either a contour or a shaded-relief edition.

RED BLUFF EAST—Tehama†
RED BLUFF WEST—Tehama†
ROCKY HILL—Tulare†
RUTHERFORD—Napa
SAN MIGUEL—San Luis Obispo
SANTA PAULA PEAK—Ventura†
SHOSHONE*—Inyo†
SIMI—Ventura†
SONOMA—Sonoma
STOCKDALE MOUNTAIN—Monterey†
STUMP SPRING—El Dorado†
VENICE—Los Angeles†
VENTURA—Ventura†
VALLETON—Monterey†
WARNER SPRINGS*— San Diego
WEST OF GERBER—Tehama
YORK MOUNTAIN—San Luis Obispo†
YOUNTVILLE—Napa†

California-Arizona

BIG MARIA MOUNTAINS*—Riverside
BLYTHE NE—Riverside

California-Oregon

MT. DOME*—Siskiyou

Colorado

ANTELOPE SPRINGS—Morgan
FALCON—El Paso†
GALIEN—Logan†
HYGIENE—Boulder
MERINO SW—Washington
REIRADON HILL—Logan†
ROGGEN—Weld†
STERLING SOUTH—Logan†
STERLING NORTH—Logan†
WIGGINS SW—Weld
WILD HORSE LAKE—Logan†
WILLARD—Logan

Colorado-Kansas

BONNY RESERVOIR*—Yuma

Georgia

CLEVELAND—White
YATESVILLE*—Upson

Idaho

BIG FOOT BUTTE*—Ada
BRUNEAU*—Owyhee
HAWLEY GULCH—Madison
HIGHAM PEAK—Bingham†
MOODY—Madison†
OREANA*—Owyhee
PASADENA VALLEY*—Elmore
WHITE OWL BUTTE—Madison†

Illinois

AMBOY*—Lee
LEROY*—McLean
MINIER*—Taswell

Indiana

BRAZIL EAST—Clay
BRAZIL WEST—Clay
NEW GOSHEN—Vigo
NORTH WEBSTER—Kosciusko
ORMAS—Whitley
ROSEDALE—Parke

Iowa

OGDEN*—Boone

Kansas

ACHILLES*—Rawlins
ATWOOD*—Rawlins†
CHARDON*—Rawlins
HERNDON*—Rawlins†
KANONA*—Decatur†
MODOC*—Scott
NORCATUR*—Decatur
NORTON*—Norton†
OBERLIN*—Decatur
OZAWKIE—Jefferson†
SELDEN*—Sheridan

Kentucky

BIG CLIFTY—Grayson
BRUIN—Eliot
CONSTANTINE—Breckenridge
GLENCOE—Gallatin
HOWE VALLEY—Hardin†
NEW LIBERTY—Owen
OAKTON—Hickman
OWENTON—Owen
SANDY HOOK—Eliot
SHEPHERDSVILLE—Bullitt†
SOLDIER—Carter
SUMMIT—Hardin
TONIEVILLE—Larue
TYGARTS VALLEY—Greenup
UNION—Boone†
WOODBURN—Warren

Kentucky-Tennessee

ADAIRVILLE—Logan

Louisiana

BERNICE*—Union
BERTRANDVILLE—Plaquemines
CHEF MENTEUR—Orleans
CYPREMORT POINT—St. Mary
DELACROIX—Plaquemines
GUY—Allen†
MARTELLO CASTLE—St. Bernard
NORTH SHORE—St. Tammany
SOUTH POINT—Orleans
SUGARTOWN—Beauregard†
SUMMERFIELD*—Claiborne

Maine

CALAIS—Washington†
DEVILS HEAD—Washington†
EASTPORT—Washington†
GREENVILLE*—Piscataquis
RED BEACH—Washington†
SEBEC LAKE*—Piscataquis†

Massachusetts

SALEM—Essex†
STERLING—Worcester†

Minnesota

EVELETH—St. Louis†
KINNEY—St. Louis†

Missouri

BRUNSWICK EAST—Chariton
BRUNSWICK WEST—Chariton
CABOOL NE—Texas†
CABOOL SE—Texas
CEDARGROVE—Shannon
DARLINGTON*—Gentry
HALE*—Carroll
HARTSHORN—Texas
HOUSTON—Texas†
LEWIS HOLLOW—Shannon†
LICKING—Texas
MIAMI—Saline
MONTAUK—Dent
NEW FRANKFORT—Saline
PRESCOTT—Texas†
RAYMONDVILLE—Texas†
STANDISH—Carroll†
UTICA*—Livingston

Missouri-Illinois

COLUMBIA BOTTOM—St. Louis

Montana

CALAIS—Roosevelt
CANYON FERRY*—Lewis and Clark
COLLINS*—Teton
COYOTE COULEE—Roosevelt†
DUTTON*—Teton
FAIRFIELD*—Teton
IBEX MOUNTAIN—Park†
JEFFERSON CITY*—Jefferson
SHIPPE CANYON—Sheridan†
VARNEY*—Madison†

Nebraska

ANSELMO—Custer†
ANSLEY—Custer†
ANSLEY NE—Custer†
BROKEN BOW—Custer†
BROKEN BOW NE—Custer†
WESTERVILLE—Custer†

Nevada

GREEN SPRINGS*—White Pine
ILLIPAH*—White Pine†
PANCAKE SUMMIT*—White Pine†

New Hampshire-Massachusetts

EXETER—Rockingham

New Jersey

CAKEPOULIN CREEK—Hunterdon†
PRINCETON—Mercer

New Mexico

PARKER LAKE—Doña Ana

New York

ALPINE—Schuyler
BRISTOL CENTER—Ontario†
CANANDAIGUA—Ontario†
HONEOYE—Ontario
LEICESTER—Livingston
MECKLENBURG—Schuyler
REMINGTON CORNERS—Lewis†
RICHFORD—Tioga
ROME*—Oneida†
RUSH—Monroe
WEST DANBY—Tompkins

New York-Vermont

CROWN POINT—Essex
PUTNAM—Washington
TICONDEROGA—Essex
WHITEHALL—Washington

North Carolina

AURORA—Beaufort†
BATH—Beaufort†
BLUFF POINT—Hyde†
BROWNS SUMMIT—Guilford
DERITA—Mecklenburg†
ELLER—Davidson
FARRINGTON—Chatham
GREAT ISLAND—Hyde
HIGH POINT WEST—Guilford
LAKE BRANDT—Guilford
MIDDLETOWN—Hyde
MIDDLETOWN ANCHORAGE—Hyde†
PAMLICO POINT—Pamlico
PAW CREEK—Mecklenburg
PINETOWN—Beaufort†
POLLOCKVILLE—Jones
VANDEMERE—Pamlico

North Dakota

DOVER—Wells
McKENZIE*—Burleigh
MENOKEN*—Burleigh†
SYKESTON—Wells

Oklahoma

BINGER*—Caddo
BRITTON*—Oklahoma†
FORT COBB*—Caddo†

Oklahoma-Texas

MILLERTON—McCurtain

Oregon

JAMIESON*—Malheur
MALHEUR BUTTE—Malheur

Oregon-Idaho

MOORES HOLLOW—Malheur

Pennsylvania

ANTRIM*—Tioga
CROSBY*—McKean
EMPORIUM*—Cameron
MERCERSBURG—Franklin
MESHOPPEN*—Wyoming
TUNKHANNOCK*—Wyoming

South Dakota

BELVEDERE SW—Jackson
BUFFALO GAP—Custer

CUNY TABLE EAST—Shannon†
HOT SPRINGS—Fall River
KADOKA—Jackson
SHEEP MOUNTAIN TABLE—Pennington
STIRK TABLE—Shannon†

Tennessee

BATH SPRINGS—Decatur
CHEWALLA—McNairy†
CLIFTON—Wayne
COUNCE—Hardin
DANCYVILLE—Haywood
EAGLE CREEK—Wayne
ENVILLE—Chester
GUYS—McNairy†
HOOKERS BEND—Hardin
JOHNSONVILLE—Hum[illegible]reys
LAMBERT—Fayette†
LEAPWOOD—McNairy
LIFE—Henderson
MARTHA—Wilson†
MILLEDGEVILLE—McNairy
MT. PETER—McNairy
OLIVEHILL—Hardin
PITTSBURG LANDING—Hardin
POPE—Perry
PURDY—McNairy
REAGAN—Henderson†
ROSE CREEK—McNairy
SARDIS—Henderson
SAVANNAH—Hardin†
STANTONVILLE—McNairy†
THURMAN—Decatur

Texas

CORPUS CHRISTI*—Nueces
CORPUS CHRISTI—Nueces
CARANCAHUA LAKE—Galveston†
CLIFTON BY THE SEA—Galveston
DELL CITY*—Hudspeth†
ELKHART*—Anderson
FROZEN POINT—Chambers
HIGH ISLAND—Galveston
JACKSONVILLE*—Cherokee
LAKE COMO—Galveston†
LAKE STEVENSON—Chambers
MANCHESTER—Red River†
PORTLAND—St. Patricio
RED BILLS*—Hudspeth†
SAN LUIS PASS—Galveston
SMITH POINT—Chambers
THE JETTIES—Galveston†
VIRGINIA POINT—Galveston†
WHITES BAYOU—Liberty

Texas-Oklahoma

KIOMATIA—Red River
NEGLEY—Red River

Utah

AVON—Iron†
BLAIR BASIN—Uintah†
BURNT CABIN GORGE—Uintah
DYER MOUNTAIN—Uintah
SALTAIR—Salt Lake
SARATOGA SPRINGS—Utah†

Virginia

BOWERS HILL—Norfolk
CAPE HENRY—Princess Anne†
ELLISTON*—Montgomery
LEES MILL POND—Loudoun
NANDUA CREEK—Accomack
PEAKS OF OTTER*—Bedford
PRINCE GEORGE—Prince George†
UPPER ZION—Caroline

Virginia-Maryland

STERLING—Loudoun
STRATFORD—Westmoreland
VIENNA—Fairfax

Washington

INCHELIUM*—Perry
SPOKANE NE—Spokane†
SPOKANE NW—Spokane†
SPOKANE SE—Spokane†
SPOKANE SW—Spokane†

Washington-Idaho

MT. SPOKANE*—Spokane

Wyoming

ALCOVA—Natrona†
ALCOVA SE—Natrona†
ANTELOPE GAP—Platte†
BENTON BASIN—Platte†
BENTON BASIN SW—Natrona†
BESSEMER MOUNTAIN—Natrona†
BUCKLIN RESERVOIR—Carbon
BURLINGTON—Big Horn†
CLARKSON HILL—Natrona†
DUTCH NICK FLAT—Washakie†
DWYER—Platte†
EMIGRANT GAP—Natrona†
EMIGRANT GAP NE—Natrona†
GOOSE EGG—Natrona†
LOOKOUT BUTTE SW—Fremont†
MEXICAN PASS SW—Fremont
OCEAN LOKE—Fremont†
OIL MOUNTAIN—Natrona†
PAT O'HARA MOUNTAIN*—Park†
PAVILLION—Fremont†
PAVILLION BUTTE—Fremont†
POISON SPIDER—Natrona†
RIVERTON EAST—Fremont†
ROCKEAGLE—Goshen†
SCHUSTER FLATS—Washakie†
SCHUSTER FLATS NE—Big Horn
SCHUSTER FLATS NW—Big Horn
SHOTGUN BUTTE—Fremont†
SUCKER DAM—Washakie
WHEATLAND—Platte†
Y U BENCH NW—Park†

Wyoming-Montana

CLARK*—Park

In addition to the standard series of quadrangle maps, reconnaissance maps at the scale of 1:250,000 are being published for both the continental United States and Alaska. Maps in this series published in the period include the following:

Alaska

ATKA—Third Judicial Division†
ATTU‡—Third Judicial Division†
CHANDLER LAKE—Second Judicial Division
GARELOI ISLAND‡—Third Judicial Division†
IDITAROD‡—Fourth Judicial Division†
KARLUK—Third Judicial Division†
KISKA‡—Third Judicial Division†
MT. KATMAI‡—Third Judicial Division†
MT. ST. ELIAS—First Judicial Division†
PRINCE RUPERT—First Judicial Division†
RAT ISLAND‡—Third Judicial Division†
SAMALGA ISLAND—Third Judicial Division†
SEGUAM—Third Judicial Division†
TELLER‡—Second Judicial Division†
UMNAK‡—Third Judicial Division†
UNALASKA‡—Third Judicial Division

Lightweight Triangulation Tower

THE Army's Engineer Research and Development Laboratories at Fort Belvoir, Va., have developed a new, lightweight, air-transportable triangulation tower which can be erected to heights varying from 37 to 103 feet in less than one working day by an experienced five-man crew. Its structural members are made of aluminum and weigh only 3,617 pounds—3,020 pounds less than the standard World War II steel towers of the same height. The entire ensemble, complete with two sets of anchors, platforms, extra bolts, and a small chest for small parts, weighs 4,152 pounds.

The new tower, when dismantled, can be transported easily in a standard Army 2½-ton truck, and it can be dropped from a helicopter to troops in inaccessible areas without suffering extensive damage.

The new structure, whose longest member is 14 feet and whose heaviest member weighs but 60 pounds, is actually two mutually independent towers in one. The inner tripod is fitted with an instrument table while the outer one (113 feet high) serves as a working platform for the observer and his recorder, and as a support for signal lamps used as targets. The tripods are completely separated to prevent the surveyor's movements from disturbing the delicate adjustments of the instrument on the inner tower.

Comment and Discussion

The pages of SURVEYING AND MAPPING are open to a free and temperate discussion of all matters pertaining to the interests of the CONGRESS. It is the purpose of this Department to encourage comments on published material or the presentation of new ideas in an informal way.

—EDITOR

"SURVEYING WITH THE MAGNETIC COMPASS"

J. H. NELSON*—The article "Surveying with the Magnetic Compass," by S. E. Huey, in the July–September 1952 issue of Surveying and Mapping, was read with considerable interest. The subject is a practical one, and the author provides an orderly outline of a method of using a surveyor's transit for running a compass traverse. Experience with surveyor's transits, however, and with measurements of the earth's magnetic field indicates that the precision obtainable with the compass is not as high as indicated by Mr. Huey.

Lines of equal magnetic declination, called isogonic lines, on aeronautical and other types of charts represent smoothed or average values from many magnetic observations. The detailed distribution of the magnetic field at ground level is, in nearly all areas, far from ideal. For this reason a precisely measured value of declination at a given point is likely to disagree with the chart, sometimes by half a degree or more. Indeed, values of declination at two locations only a fraction of a mile apart could easily differ from one another by a whole degree, even though the two points were selected on the same isogonic line of the best available chart. Discrepancies of a few minutes are common even in relatively undisturbed localities. It is evident, therefore, that the index error of a surveyor's compass cannot be reliably determined by using a chart value of declination. The degree of uncertainty will depend on the intensity of local magnetic irregularity or local distortion of the earth's field in the region.

True directions at magnetic stations are determined by reference to triangulation stations or by celestial observations. The direction of *magnetic* north is then determined with a magnetometer or declinometer whose index error has previously been measured by observations at a place of *known* declination, such as a magnetic observatory. Even with this sort of calibration of the declinometer or compass, an accuracy of 1 minute of arc for single field observations is seldom, if ever, achieved.

Accurate corrections for transient daily variations can be made only with the help of simultaneous measurements made at a fixed base station where observations (or preferably continuous recordings) have been made for a long conugh period to establish a mean station value of declination—a procedure that requires a minimum of several days. Mean daily-variation curves, as published, are based on hourly averages over a period of months or years. Differences between the variation curve of any specific day and the mean curve may sometimes be as large as 10 minutes of arc, even on magnetically quiet days; and it would be indeed phenomenal if the actual value of declination agreed with the mean curve throughout a whole day within 1 minute of arc. While using a mean curve is better than ignoring the effect, it seems clear that such use could not achieve 1-minute accuracy.

Mr. Huey's statements about reading his compass needle to an accuracy of 1 minute are a little surprising. When a transit magnetometer, an especially built surveyor's transit equipped with a microscope for reading the position of the compass needle, is calibrated at a magnetic observatory, a series of pointings on the needle will nearly always show a spread of 2 to 4 minutes of arc. It might be pointed out that the end of a 4-inch compass needle is displaced only a little over half a thousandth of an inch for a 1-minute angular movement.

Mr. Huey is to be commended for his realization that a compass must be standardized before it can be used for accurate work, and for his recognition that many compasses are unsuitable for any use at all, because of inferior ma-

* Chief, Geomagnetism Branch, Division of Geophysics, U. S. Coast and Geodetic Survey.

terials used in their construction or because of damage to pivots and jewels resulting from rough handling. However, he seems to overlook some of the errors inherent in even the best surveys by compass, and he may, therefore, mislead his readers to the extent of suggesting a confidence in precise compass work that is not quite justified.

A FORTUNATE COINCIDENCE

S. A. BAUER†—Recently I attended a seminar of practicing surveyors at the University of Wisconsin. One of the speakers, Prof. L. F. Van Hagan, in the course of his paper, displayed a copy of SURVEYING AND MAPPING, which he had just discovered, to his surprise. He had not known that there was any current surveying literature. He recommended the Journal very highly from the standpoint of appearance and context, and recommended that investigation be made as to its availability.

I was asked to comment on his speech, and I began by saying that, by a strange coincidence, I had the information as to the availability of the publication, and with that I handed out fifteen or twenty membership application blanks which were picked up by the crowd.

† Member of the Board of Direction and a Past President of ACSM.

CORRECTION

WILLIAM A. WHITE*—In a letter published in the July-September issue of SURVEYING AND MAPPING, Forrest Daniell mentioned that "George C. Bestor, in a letter to S. A. Bauer some time ago, was indignant at the fact that the California State Board of Registration for Civil and Professional Engineers does not consider surveying a branch of engineering, and yet the Board grants permission to perform any service a licensed surveyor can do in California if he passes the civil engineering examination." I believe Mr. Bestor's statement should be corrected.

The distinction between land surveying and civil engineering is established by statute in California. The Civil and Professional Engineers Act (Section 6731) defines civil engineering. This definition of civil engineering contains no mention of boundary surveys as being in the field of civil engineering; accordingly the board has no authority to so consider it.

Similarly it is the law (Land Surveyors Act, Section 8731) and not the Board which grants registered civil engineers the right to do land surveying.

* Executive Secretary, California State Board of Registration for Civil and Professional Engineers.

INDIANA LAND SURVEYORS

In a letter to the Congress, W. B. Williams, who is a director of the Michigan Society of Registered Land Surveyors and a member of the National Advisory Council of ACSM, states:

"Last Thursday [January 15, 1953] I had the pleasure of being present at the birth of the Indiana Society of Registered Land Surveyors, and it is one healthy baby, believe me. They had about 50 registrations and had a fine time."

CONGRESS NEWS

The Board of Direction

The Board of Direction of ACSM is its governing body. It consists of the President, who serves as Chairman; the Vice President; the Executive Secretary; the Treasurer; the Editor-in-Chief; and the twelve Directors. The Board meets at the time of the Annual Meeting and at such other times as may be deemed necessary by the Executive Committee.

During the year 1952 the Board met four times: January 12, April 22, June 14, and December 12.

Since many of the actions of the Board are of general interest to the members, and since the Journal is the medium for dissemination of information of this type, periodic reports of these actions will be abstracted from the Executive Secretary's minutes and published.

At its meeting on December 12, 1952, the following business of interest to all members was conducted:

(1) Robert H. Lyddan, Deputy Chairman of the Professional Status Committee read the brief letter report of Chairman Sol A. Bauer. (A later and more complete report appears under Congress News in this issue.)

(2) Executive Secretary Walter S. Dix presented the report of the Constitution and By-Laws Committee. This committee, one of the several continuing committees of the Congress, is charged with the study of the Constitution and with recommending revisions for improvement at the Annual Meeting. It has under study several such revisions, but is unanimous in its opinion that it would be unwise to attempt hasty consideration prior to the advanced 1953 Annual Meeting.

(3) Chairman Murray Y. Poling reported on progress and plans for the Thirteenth Annual Meeting scheduled for March 23, 24, and 25, 1953. He stated that Exhibits Chairman Emory Hall reported a good participation of exhibitors is indicated, that Program Chairman Robert Randall reported all speakers had been engaged, and that Robert W. Evans had been designated Financial Secretary for the Meeting. All committees were reported hard at work to insure an outstanding meeting.

(4) President Harding presented two matters which have been under consideration for some time. The first concerns the possibility of joint or consecutive meetings of ACSM with the American Society of Photogrammetry. He pointed out that this idea is currently being explored by ASP with the thought of creating a "Surveying Week." President Harding stated that the solution to conflict between the ACSM and ASP annual meetings was to have them either as far apart in timing as possible or as close together. He explained, however, that ACSM advanced its meeting date from June to March because of the fact that June is the busiest time of the year for practicing surveyors, who comprise about 47% of the membership, and for the Education Division members, who are occupied with final examinations, commencements, and summer survey camps.

Since the ASP had already appointed a committee to study the matter, a motion was carried authorizing President Harding to appoint a similar committee to meet with the ASP committee, to study the matter, and to report decisions and recommendations for action. President Harding directed that an ad hoc committee be appointed by the Executive Secretary, if necessary for action before such committee was appointed by incoming-President Studds.

The second item presented by President Harding was the matter of possible consolidation of office space, facilities, and routine staffs with one or two other kindred societies in the interest of mutual benefit and economy in meeting the increasing workloads of these growing organizations, and in the interest of acquiring an established headquarters.

A motion was made and carried that another committee be set up to investigate the feasibility and desirability of such a consolidated venture.

Another meeting of the Board of Direction was held on January 22, 1953, at which the following business of importance to all members was transacted:

(1) The nominations by President Studds of

1953 appointive officers Walter S. Dix, Executive Secretary; Richard T. Evans, Treasurer; and Robert C. Eller, Editor-in-Chief; were approved by the Board.

(2) Directors Robert H. Lyddan and Frank S. Borden were designated as Board representatives on the Executive Committee.

(3) The Ad Hoc Committee, which had been activated to study and report on the possibility of joint or consecutive annual meetings with the ASP and the feasibility of consolidation of office space and facilities with other societies, reported, through its Chairman, Shirley V. Griffith, that a meeting had been held at which these matters were discussed in considerable detail and that liaison meetings with similar committees of ASP were scheduled. Two new committees pertinent to the two distinct matters involved were appointed to replace the single committee and to continue liaison and investigation.

(4) The following were approved as chairmen of standing committees for 1953:

Committee	*Chairman*
Annual Meeting	Murray Y. Poling
Budget	John M. Amstadt
Constitution	William T. Pryor
Map Use	Walter G. Stoneman
Membership	Frank S. Borden
Professional Status	Sol A. Bauer
Publications	Morris M. Thompson
Public Relations	Murray Y. Poling

ACSM Creates a Professional Status Committee

In October 1951 the United States Civil Service Commission transferred all surveying and mapping personnel in the various Federal departments from the existing "Engineering Series" to a newly created "Cartographic Series." This change suddenly highlighted many of the problems facing the surveying and mapping profession. Although the ruling itself applies directly only to those in Federal employ, its potentialities and ramifications extend to all levels and phases of surveying and mapping throughout the country.

The significance of the new ruling was brought to the attention of the American Society of Civil Engineers and the National Society of Professional Engineers, which societies expressed their opinions in resolutions of protest against the reclassification.

A similar resolution was introduced at the 1952 Annual Meeting of the Congress in June. At the subsequent meeting of the Board of Direction of the Congress, the proposed resolution was reviewed. Since the reclassification was already an accomplished fact, it was decided that further resolutions of protest would serve no useful purpose. Instead, Prof. George H. Harding, then president of the Congress, appointed a Professional Status Committee, whose function it would be to study all matters pertaining to the current and future welfare of surveyors and mappers in all fields of activity, and to attempt to chart a course of action for professional policy to guide the activities of the Congress in years to come.

The following men were appointed to serve on this committee, under the chairmanship of past president Sol A. Bauer.

Talbert Abrams, photogrammetrist and manufacturer of photogrammetric equipment; past president of the American Society of Photogrammetry.

B. Everett Beavin, consulting engineer, Baltimore, Md.

G. W. Herzog, Engineer for the Shell Oil Co.

Robert Lyddan, U. S. Geological Survey.

Gordon Littlepage, U. S. Coast & Geodetic Survey.

Prof. Arthur McNair, professor of surveying, Cornell University.

W. H. Miller, Director of Surveys and Mapping Branch, Department of Mines and Technical Surveys of Canada, acting in a consulting capacity.

This committee is to be a continuing committee. The functions of the committee are two-fold:

(1) To follow and advise the Board of Direction of the Congress on matters of immediate concern to surveyors and mappers. Under this category would come such matters as the immediate problems that might develop under the reclassification, as well as such matters as lending aid to state organizations attempting to create or perfect surveyors' registration acts, and similar current problems.

(2) To formulate a long term policy for the profession, in order that ultimately the true importance of surveying and mapping to the economic welfare of the country will be fully recog-

nized. This long term task is one of extreme difficulty, requiring the best thought that can be developed by the Congress.

Before much long term planning can be done, the following questions must be answered:

(1) Under what general heading of activity does surveying and mapping logically come? Are we a branch of engineering, are we more closely related to the applied scientists, or are we a part of some other major field of activity?

(2) What over-all name most clearly represents our field of activity? The name "Cartography," now being used by the U. S. Civil Service Commission, does not meet with much favor, primarily because under that over-all name must necessarily appear a sub-branch of the same name, to cover the technical operations of map production.

(3) How are we to provide our ever increasing sphere of activity with an educational background, while our civil engineering colleges become more and more specialized in the limited field of construction and design for construction, alloting less and less time to surveying education?

As yet, no conclusions have been reached. Many thoughts have been expressed, and the opinions of many men have been obtained. An enthusiastic discussion of phases of the problem was held at the Congress meeting at the Centennial of Engineering at Chicago in September 1952. The Texas Section of the Congress has appointed a Committee on Professional Status which is serving a valuable purpose in providing the major committee with additional viewpoints. The opinions of other groups and individuals will at all times be welcomed and carefully considered by the Status Committee.

It was the opinion of the Board, in creating the Professional Status Committee, that we, as a profession, stand at the dawn of a new day. During the past twenty years the uses and techniques of surveying and mapping have increased at a rate never known before. New methods have introduced new complexities, new basic sciences, and new responsibilities. Those responsibilities must be faced and met by the profession. By so doing, we shall go a long way toward creating for ourselves the professional status and the public esteem to which our work entitles us.

—Sol A. Bauer
Committee Chairman

Cartography and Topography Divisions Joint Meeting

The fall local evening meeting of Congress members in the Washington area under the joint sponsorship of the Cartography and Topography Technical Divisions was held in the Interior Department Auditorium, November 6, 1952, C. S. Maltby, Chairman, Technical Division on Topography, presiding.

Approximately 200 ACSM members and guests turned out for the program.

Ralph Higgs, Special Assistant to Chief, Forecast Division, U. S. Weather Bureau, gave a brief account of the work of the Bureau, particularly as regards the charting of hurricanes. The talk was followed by a motion picture "Hurricane Circuits," produced by the Weather Bureau and the U. S. Navy.

C. H. Davey, Chief, Topographic Surveys Section, U. S. Geological Survey, presented a paper "Vertical Accuracy of Topographic Maps." This paper appears elsewhere in this issue of Surveying and Mapping. At the conclusion of Mr. Davey's talk, Robert A. Cummings of Robert A. Cummings and Associates, Pittsburgh, Pa., presented a three-dimensional colored motion picture "Preparation of Topographic Maps."

Texas Section

The Directors of the Texas Section met at the Houston Engineers' Club on September 17, 1952, to make plans for the annual meeting. It was agreed that it would be a social dinner meeting at which officers for the ensuing year would be elected. December 5, 1952, was agreed to as a tentative date for the annual meeting. The names of new members were announced and the program for the October meeting was discussed.

The sixth meeting of the Texas Section was held on Friday evening, October 17, in the Houston Chamber of Commerce Auditorium. O. E. Young, Chairman of the Texas Section, welcomed the new members who had recently joined and paid tribute to Charles W. Atkinson, a member who was recently killed on a Houston road while engaged in his profession of land surveying.

The program at the sixth meeting was a panel discussion in two parts: *first*, the ACSM TECHNICAL STANDARDS FOR PROPERTY SURVEYS were discussed by J. S. Boyles, consulting civil engineer and land surveyor, and R. K. Daley, in charge of surveys and maps for Stanolind Oil and Gas Company; and *second*, the ACSM-recommended EQUITABLE FEES FOR PROPERTY SURVEYS were discussed by R. M. Atkinson, consulting civil engineer and land surveyor, and Forrest Daniell, a former county surveyor who is now a civil engineer and land surveyor for the Texas Company.

A copy each of the STANDARDS and the FEE RECOMMENDATIONS was sent with the notice of the meeting to each member of the Section and to other interested persons in the area. This was to acquaint those attending the meeting with the subject matters to be discussed.

E. D. Morse, an engineer with the Houston Lighting and Power Company and program chairman of the Section, served as moderator of the panel discussion. He called attention to the fact that many of the bench marks in Houston have been lost and that a complete resurvey is needed. He estimated roughly that a complete survey of Houston and of Harris County would cost a possible $10,000,000 to bring it up to the standard of that of Baltimore, Md., which, he said, has one of the best survey systems in the United States. Such a survey should be made over a period of years.

J. S. Boyles, in his discussion, brought out the fact that when Main Street was paved the monuments were destroyed and now it is necessary to base surveys of property on this street on monuments four or five blocks away.

He reported that one 1500-lot subdivision in Houston had been so badly surveyed that it was in error by a block and a half and that no property owner there can establish the boundary lines of the land he is supposed to own. He said that the subdivision should be completely resurveyed and replotted.

Another older subdivision was identified which, he said, is several varas in error and the map of the subdivision was never recorded. Ownership in this subdivision has been established by the statute of limitation.

The speaker described these as examples of incompetent and slipshod surveying and illustrative of the difference between a "jack-leg" surveyor and a real surveyor. He told a story of encountering a blacksmith who was acting as county surveyor of a West Texas county, although he didn't know the first thing about surveying, and he said that he met a county surveyor in another Texas county who had an instrument that he called a "philly," but that all he knew about the instrument was that it had been made in Philadelphia.

R. M. Atkinson said that various factors should be taken into consideration in fixing a surveyor's fee but he fixed the "rock-bottom" fee for a surveyor just starting out at no less than his total expenses plus 100 per cent.

Forrest Daniell recommended that the services of a surveyor should be negotiated for on the same basis that one selects a physician or a lawyer. He said that the profession has the responsibility of protecting the public from substandard surveying.

W. H. Wilson, civil engineer of Humble Oil and Refining Company, and Charles P. McKnight, chief civil engineer of the Houston Oil Company of Texas, gave papers from the floor on map abstracting and legal work connected with the surveying profession. Other members present asked questions of the panel members.

The annual meeting of the Texas Section was held on December 5, 1952, at Cousin's Cafe in Houston. The retiring chairman, O. E. Young, assistant chief engineer of Humble Oil and Refining Company, presided at the meeting, attended by 60 members and guests, who enjoyed cocktails and a steak or flounder dinner.

The following officers were elected for 1953:

Chairman—E. D. Morse, Houston Lighting and Power Company
First Vice Chairman—R. M. Atkinson, Civil Engineer and Land Surveyor
Second Vice Chairman—V. A. Walston, Humble Oil and Refining Company
Third Vice Chairman—Jeff Stramler, Stramler and Miller
Secretary—H. E. Mason, Humble Oil and Refining Company
Treasurer—H. Alton Allen, Southwestern Bell Telephone Company
Directors for 2 years—R. L. Sargent, R. L. Sargent Company, and J. O. Phillips, Pan American Prod. Company

Annual reports were made by the chairmen of the Arrangement Committee, the Membership Committee, and the Committee on Professional Status. The chairman of the Membership Committee announced an increase of 34 new members during 1952, bringing the total membership of the Section to 118.

E. D. Morse, chairman of the Program Committee, reviewed the programs of 1952 and outlined the proposed programs for 1953. He noted that the growth of the Section had been gratifying but pointed out that the membership could be greatly expanded, and stressed particularly the importance of enlisting the active participation of surveyors and mappers engaged in private practice.

FORREST DANIELL
Assistant Editor

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Northern California Section

The Northern California Section has been patterned after the Congress. Two meetings a year are held, alternately at Sacramento and San Francisco. The annual meeting was held on October 17, 1952, in Sacramento, and featured the U. S. Geological Survey training film "Preparation of Topographic Manuscripts for Reproduction," and an illustrated talk by Leon A. Hostetter of the International Engineering Company of San Francisco. His speech, "Engineering Developments in the Far East," was accompanied by a series of Kodachrome slides covering his work and travels around the world.

The following Section officers and directors for 1953 were elected:

Officers

C. J. Aggeler, *Chairman*
C. O. Greenwood, Jr., *Vice Chairman*
L. N. Muir, Jr., *Secretary-Treasurer*
C. A. Wooldridge, Jr., *Editor*

Directors

C. A. Biever	(1952–3)
H. W. Waterfall	(1952–3)
H. J. Hall	(1953–4)
W. E. Dutra	(1953–4)

The Section, like the Congress, has provision for Technical Discussion Groups. The Property Surveys Division is the only such group at this time, and the following Divisional officers for 1953 were also elected at the October meeting:

C. A. Baker, *Chairman*
D. H. Dean, *Vice Chairman*
G. C. Bestor, *Vice Chairman*
P. J. Dowling, *Vice Chairman*
C. A. Wooldridge, Jr., *Secretary-Treasurer*

The Property Surveys Division has had very interesting meetings during the past year starting with the organizational meeting last June, and is looking forward to having monthly meetings ultimately. E. R. Jones of the University of California outlined the educational opportunities for surveyors. As a result of the ensuing discussion at this meeting, the University is currently conducting an evening course devoted exclusively to the legal aspects of boundary surveys.

"Prices, Precision and Accuracy" was the subject of a panel discussion in September. Two recent programs for promoting the State Coordinate System were outlined and discussed at the December meeting. One group consists of city, county, and private engineers of four counties attempting to obtain a control survey project in cooperation with the U. S. Coast and Geodetic Survey. The East Bay Council on Surveying and Mapping is a similar group attempting to promote supplemental control surveys, and to coordinate, standardize, and improve the work of the various organizations. The Council will also assist the two County Surveyors involved by becoming a central re-

pository for data regarding control monuments established by the various agencies.

"Engineers and Labor Union" was the subject of Harold Ringrose, Labor Director of the Northern California Chapter of the Associated General Contractors, at the January meeting.

C. A. WOOLDRIDGE, JR.
Editor

Virginia Association of Surveyors Annual Meeting

The Fifth Annual Meeting of the Virginia Association of Surveyors was held January 30–31, 1953, in historic Williamsburg, Va. Some 60 surveyors and wives heard talks by Gen. James A. Anderson, Commissioner of Highways for Virginia and the Hon. Joseph J. Williams, Jr., of the Virginia House of Delegates. Honorary membership was presented to J. Temple Waddill of Richmond and Fred E. Ruediger of Accomac, who were original members of the Examining Board, served for about 22 years, and made outstanding contributions to surveying progress in the State.

Discussion followed the talk on title work by John C. Kenny of Lawyers Title Insurance Corporation and also the talk by A. T. Dotson on subdivision law application in Henrico County. Further business included approval of proposed regulations to govern examinations of surveyors and a commendation for G. Hubard Massey for the manner in which he helped raise the standards of the examination. A report was given on the steps taken in forming the Association's Northern Virginia Chapter and enough interest was shown in several other areas to indicate that new chapters will apparently have been formed by the next annual meeting.

Other progress was the purchase of an Association button and a 24-inch diameter plaque to dress up the meetings. Paid membership during the year rose from 63 to 89, with several new surveyors already signed for the current year.

Among resolutions offered was one urging the Virginia Association to lead the way toward formation of a national association of Surveyors. It was believed this could be accomplished under the auspices of the American Congress on Surveying and Mapping, possibly as a division of ACSM, or later perhaps with growth and strength to stand, as an affiliate of ACSM. Members were urged to attend the ACSM meeting in March at Washington, D. C.

The meeting closed with the banquet Saturday evening and retiring President R. V. Carter of Williamsburg turned the Association over to President-elect James D. Payne of Arlington. Other officers elected were Vice President Wilton S. Whipp of Hopewell and 2-year director Guilford L. Mattern of Roanoke. Victor H. Ghent continued as Secretary-Treasurer and F. P. Johnson as a director.

There was a conducted tour of Colonial Williamsburg Sunday morning.

—VICTOR H. GHENT

Personals

Rear Admiral Robert F. A. Studds, President of ACSM, was recently awarded the Department of Commerce gold medal for exceptional service to the U. S. Coast and Geodetic Survey for many years, and for his outstanding leadership as its Director. Admiral Studds has been with the Survey for 34 years and has been Director since 1950.

Porter-Urquhart Associated and O. J. Porter & Company have announced the addition to the firm of Benjamin E. Beavin, Sr., Vice President of ACSM for 1953. Commencing January 1, 1953, the engineering services at all former offices will be conducted in the name of Porter, Urquhart & Beavin. The firm has offices across the country.

Postponement of Nomination of Officers for 1954

At its September 15, 1952, meeting, the Constitution and By-Laws Committee of ACSM approved a recommendation by the Nominating Committee that nominations of officers for 1954 be postponed until after the Thirteenth Annual Meeting of ACSM in March. The insufficient amount of time for consideration of nominations and distribution and counting of ballots, resulting from the advancement of the date of the Annual Meeting from June to March, prompted the Nominating Committee's recommendation. The Executive Committee of ACSM, at its November 14, 1952, meeting, approved the recommendation for postponement.

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MISSISSIPPI RIVER MAPS

Two revised quadrangle maps, prepared from aerial photographs, have recently been published by the Mississippi River Commission. The quadrangles covered are Jericho, Ark.-Tenn., and Hales Point, Ark.-Tenn.

Printed in colors at the scale of 1 to 62,500, the maps show the levee system, levee mile posts, the locations of revetments and dikes, river landings, and river gage locations. Distances along the Mississippi River are shown at 5-mile intervals. An interesting feature is early river meander lines with their dates. State and county boundaries, ranges townships, section numbers, and bench mark locations are shown. Also included are contour lines with 5- and 10-foot intervals, changing at the 240-foot contour.

The Jericho quadrangle covers portions of Mississippi and Crittenden Counties, Ark., and Tipton and Shelby Counties, Tenn. It shows a 24-mile reach of the river from Chute of Island No. 35, near Pecan Point, Ark., to Hickman Bar, near Benjestown, Tenn.

The Hales Point quadrangle covers portions of Mississippi County, Ark., and Dyer and Lauderdale Counties, Tenn. It shows a 21-mile reach of the river extending from Island No. 20, just north of Huffman, Ark., to Barfield Revetment, and from Tomato Landing, Ark., to Forked Deer Island No. 26.

These maps are available at 20 cents a copy from the Mississippi River Commission, Corps of Engineers, Department of the Army, P.O. Box 80, Vicksburg, Miss. Remittance should be made payable to the Treasurer of the United States.

Reprints of Articles

Reprints may be obtained of any article appearing in this issue. Orders must be placed with the Editor-in-Chief not later than 3 weeks after publication. Authors who wish reprints of their articles may so indicate when manuscripts are submitted. The minimum reprint order is 50 copies. Approximate prices of 4- and 8-page reprints follow:

	Self-Cover		*Heavy Paper Cover*	
No. of copies	*4 pp.*	*8 pp.*	*4 pp.*	*8 pp.*
50	$12.01	$19.59	$19.08	$26.66
100	$12.48	$20.43	$21.43	$29.38
250	$13.95	$22.94	$28.54	$37.53
1000	$21.30	$35.46	$64.09	$78.25

Annual Financial Statement

(As of December 31, 1952)

INCOME

Dues and memberships received	*1951*	*1952*	Year ending 12/31/51	Year ending 12/31/52	Differences
Individual	2262	2685	$11,284.28	$13,535.21	
Library	198	209	862.66	899.91	
Sustaining	18	16	430.00	500.00	
Previous year's dues			45.00	48.00	
Total	2478	2910			
Total gross regular income			$12,621.94	$14,983.12	+$2,361.18
Deduct membership costs			*– 1,665.34*	*– 1,611.87*	*– 53.47*
Net regular income			10,956.60	13,371.25	+ 2,414.65
Publication sales			185.21	379.57	+ 194.36
Annual meeting and other income			156.34	3,850.14	+ 3,693.80
OPERATING INCOME			$11,298.15	$17,600.96	+$6,302.81

EXPENDITURES

Journal (all expenses)	$ 7,892.83	$10,439.94	+$2,547.11
Other printing	56.85	153.92	+ 97.07
Office supplies and Secretary's and Treasurer's expenses	526.78	1,078.25	+ 551.47
Technical Divisions	168.28	157.95	*– 10.33*
Other expenditures authorized by the Board of Direction	24.00	166.93	+ 142.93
TOTAL EXPENDITURES	$ 8,668.74	$11,996.99	+$3,328.25
PROFIT	$ 2,629.41	$ 5,603.97	+$2,974.56

ASSETS

Bank balance	$ 5,392.48	$ 372.77	*–$5,019.71*
Bonds and Savings Account	7,055.00	12,055.00	+ 5,000.00
Journal (back issues—estimated)	300.00	300.00	0.00
Advance payments	483.02	598.10	+ 106.08
Accounts receivable	0.00	400.00	+ 400.00
TOTAL ASSETS	$13,230.50	$13,716.87	+$ 486.37

LIABILITIES AND NET WORTH

Advance dues paid	$ 3,901.90	$ 900.12	*–$3,001.78*
Oct.–Dec. Journal	1,800.00	0.00	*– 1,800.00*
Other accounts payable	0.00	0.00	0.00
TOTAL LIABILITIES	$ 5,701.90	$ 900.12	*–$4,801.78*
NET WORTH	$ 7,528.60	$12,816.75	+$5,288.15

JOHN M. AMSTADT, *Chairman*
Budget and Finance

NEW MEMBERS

INDIVIDUAL MEMBERSHIPS

AULDS, Ellis, Houston Lighting & Power Co., 1016 Walker St., Houston, Tex.—Surveyor

BABER, Wilbur H., Jr., 4617 University Oaks, Houston Tex.—Graduate student in Engineering, University of Houston
BALEY, Jesse F., 397 Museum Dr., Los Angeles, Calif.—Field Engineering Aid, Department of Public Works
BARANOWSKI, Max A., 1600 Shearn St., Houston, Tex.—Party Chief, County Survey
BARKSDALE, John F., c/o Rycom Staff Engineer, APO 331, c/o Postmaster, San Francisco, Calif.
BAUWENS, George O., P.O. Box 58, Glendale, Utah —Consulting Engineer
BECK, Shlomo, Shchunat Ziv, Beth Misrach, Haifa, Israel
BISIO, A. Louis, 165 Beverly Rd., Wethersfield, Conn.—Office Engineer, Connecticut Light & Power Co., Hartford, Conn.
BOATNER, J. Howard, 359 S. Wilson Ave., Pasadena, Calif.—Petroleum Draftsman, Western Gulf Oil Co.
BOGGESS, Bennett L., Route 1, Box 134, Pine, Colo. —Consulting Topographer
BOUDREAUX, W. A., 226 Cenac St., Houma, La.—Seismic Party Surveyor, Shell Oil Co.
BOWLES, A. L., Route 4, Mocksville, N. C.—Land Surveyor
BUTLER, John P., Oyster Bay Cove Rd., P.O. Box 514, Oyster Bay, N. Y.—Transitman, Mark L. Diggory
BUTZ, Geo. W., 301 Centre Ave., Schuylkill Haven, Pa.—Surveyor

CASWELL, Edward C., Phillips Petroleum Co., Bartlesville, Okla.—Manager, Surveying and Mapping Branch
CHAMPAGNE, Ralph G., State St., Troy, N. Y.—City Engineer
CHASE, James W., Bonneville Power Administration, P.O. Box 3537, Portland 8, Ore.—Surveyor
CHEW, Yaw Weng, 2168-4 Kampong Pandan Qrs., Pudu, Kuala Lumpur, Malaya—Government Surveyor, Revenue Survey Office
CHRISTENSEN, D. J., Standard Oil Company of California, 225 Bush St., San Francisco 20, Calif.
COMINETTO, Tullio A., 331 W. 27th St., New York 1, N. Y.—Multiplex Map Compiler, U. S. Army

DAVATZ, Florian E., Kern Surveying Instrument Division, Paul Reinhart Co., Inc., 66 Beaver St., New York 4, N. Y.—Manager
DAVIS, James B., 2nd & Arsenal Sts., St. Louis 18, Mo.—Cartographer
DAYTON, Robert C., Shell Oil Co., P.O. Box 193, New Orleans, La.—Chief Surveyor
DeBUYS, William, 2615 Greenfield Ave., Arcadia, Calif.—Senior Draftsman, General Petroleum Corp.
DeVEAUX, Richard D., 51 Ivanhoe Dr., Merrick, N. Y.—Office Engineer, Teas and Steinbrenner
DIRECTOR, National Mapping Section, Dept. of Interior, Canberra, A.C.T., Australia
DOUGLAS, Selwyn, 10800 Kingsland St., Los Angeles 34, Calif.—Supervising Draftsman, General Petroleum Corporation

EICHELBERGER, Roy C., 1221 Adkins Rd., Houston 24, Tex.—Surveyor, G. & G. Civil Engineering Co.
ELSOM, Tom, 4032 Sul Ross St., Houston 6, Tex.—Survey Party Chief

FAIRES, Edwin L., Route 3, Charlotte, N. C.—Land Surveyor
FLEMING, Millar A., Box 392, Painesdale, Mich.—Highway Engineer, Michigan State Highway Dept.
FOSTER, Cecil J., Humble Oil & Refining Co., Room 898 Humble Bldg., Houston, Tex.—Senior Draftsman

GAMET, Merrill B., Northwestern Technological Institute, Evanston, Ill.—Professor of Civil Engineering
GARBER, Comdr. Harry F., U. S. Coast & Geodetic Survey, Dept. of Commerce, Washington 25, D. C. —Asst. Chief, Division of Charts
GATTI, Mario L., 4 School St., Windsor Locks, Conn. —Registered Professional Engineer and Land Surveyor
GOLD, Kenneth George, 5713 Beechnut St., Bellaire, Tex.—Instrument Man, Houston Lighting & Power Co.
GOLDBERG, Bernard, A/1c, 1st Comp. Tech. Sqd. A.P.O. 845, c/o Postmaster, N. Y.—Geodetic Computer and Surveyor, U.S.A.F.
GOTTSBERGER, James B., Aeronautical Chart & Information Center, Second and Arsenal Sts., St. Louis, Mo.—Cartographer

HAACK, Christian H., 11312 204th St., St. Albans, N. Y.—Bureau of Highways & Sewers, Brooklyn, N. Y.
HAGLER, John P., 1333 Warrior Rd., Birmingham, Ala.—Asst. Chief Field Engineer, Tennessee Coal & Iron Division of United States Steel
HALL, Emory, 209 North Wayne St., Apt. 2, Arlington, Va.—Special Projects, Research & Liaison Office, Aeronautical Chart and Information Center
HAYS, Gordon, Jr., P.O. Box 591, Bartow, Fla.—Instrumentman, Florida State Road Dept.
HEANEY, Harry J., 704 Joyce St., Houston, Tex.—Civil Engineer and Land Surveyor
HENDERSON, Bartholomew M., 270 West Valley Stream Blvd., Valley Stream, N. Y.—Land Surveyor, Teas and Steinbrenner
HINTON, Charles J., 129 East Ave., Lockport, N. Y. —Asst. Engineer, Niagara County Dept. of Highways
HITCH, Filbert M., 306 W. College Ave., Salisbury, Md.—Land Surveyor
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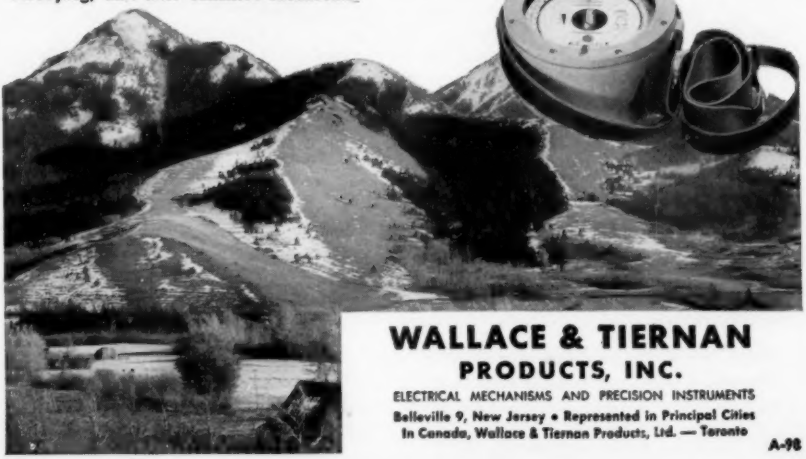

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